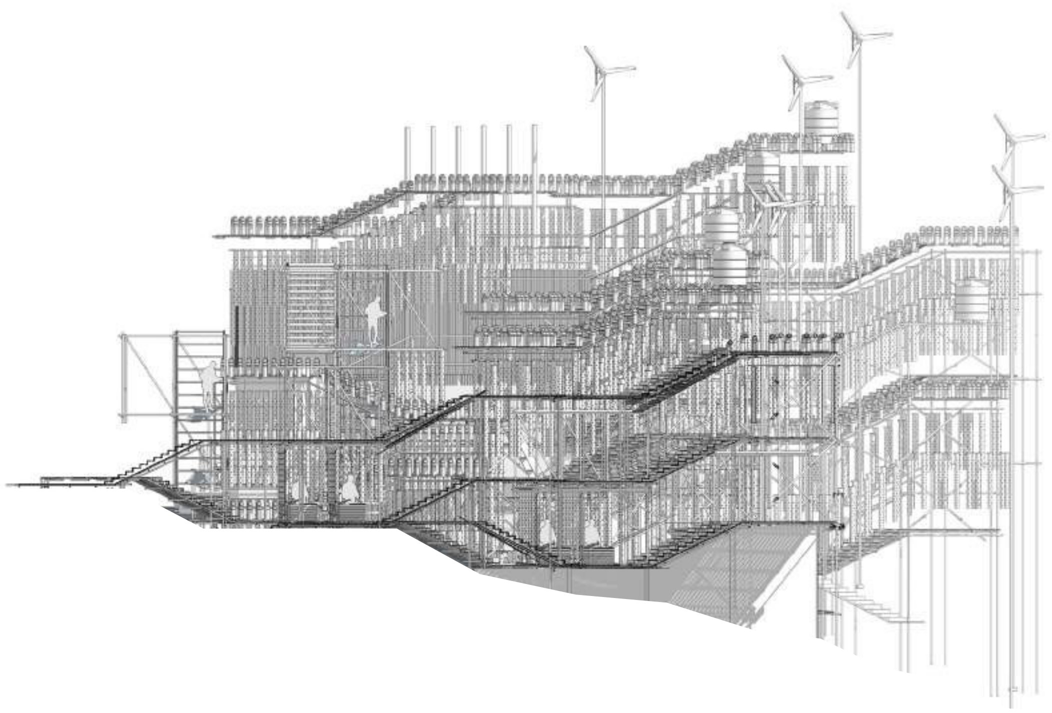

Roots orRoutes

A case for vertical farming allotments in Dunoon quarry.

Nwabisa Madyibi

Title page

Dissertation title: Roots or Routes

A case for vertical farming allotments in Dunoon quarry

A speculative dissertation on the future of urban farming machines on the fringe of Cape Town.

Student's name: Nwabisa Madyibi
Super visors: Nic Coetzer & Kevin Fellingham

This dissertation is presented as part fulfilment of the degree of Master of Architecture (Professional) in the School of Architecture, Planning and Geomatics, University of Cape Town

1 November 2017

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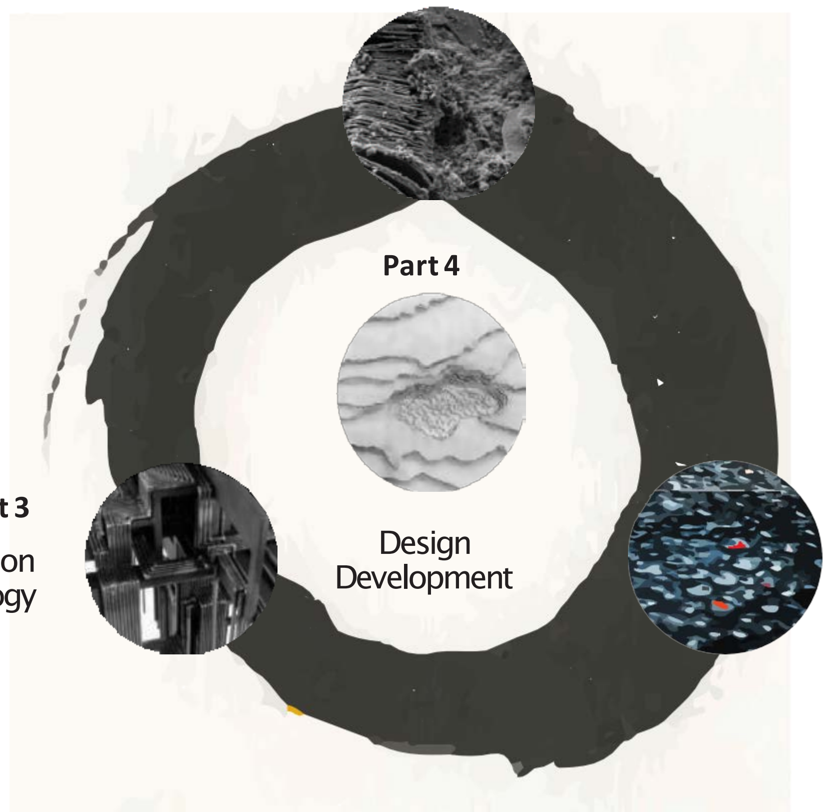
Contents



Part 1
Dunoon
Part 4
Design Development
Part 3
Intervention Technology
Part 2
Water studies

Acknowledgments

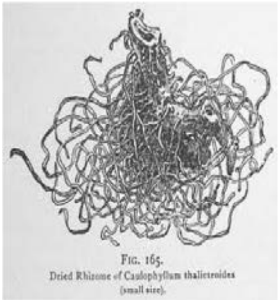
I would like to use this opportunity for an expression of my deepest gratitude to everyone who has helped me during my years of study. Firstly, I would like to thank all the contributing facilitators from the NGO My Dunoon (Christine, Johane, Farm and Lovemore) for their wealth of knowledge and guidance through the process of understanding the animal in all its complexity. I would also like to thank my supervisors, Nic Coetzer and Kevin Fellingham for their tireless encouragement, support and guidance throughout this project.

I would like to thank the South African Institute of Architects (SAIA) for financially supporting this year. I am most grateful for a family that has supported and grounded me this year. Lastly, I would like to acknowledge my creator. Through times of trial I had the wisdom of his comfort throughout this process.

“We are called to be architects of the future, not its victims.”

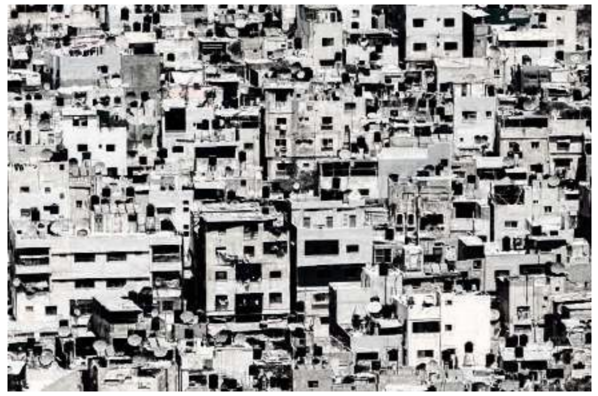
- R. Buckminster Fuller, 1969

Preface



A Dried rhizome (Jefferey, 2013)

+



Holey space has different relations to nomadic smooth and State striated space. Cave–dwelling, earth–boring tunnellers are only imperfectly controlled by the State, and often have allied with nomads and with peasants in revolts against centralized authority. Thus the machinic phylum explored in holey space connects with smooth space to form rhizomes, while it is conjugated (blocked) by State striation.

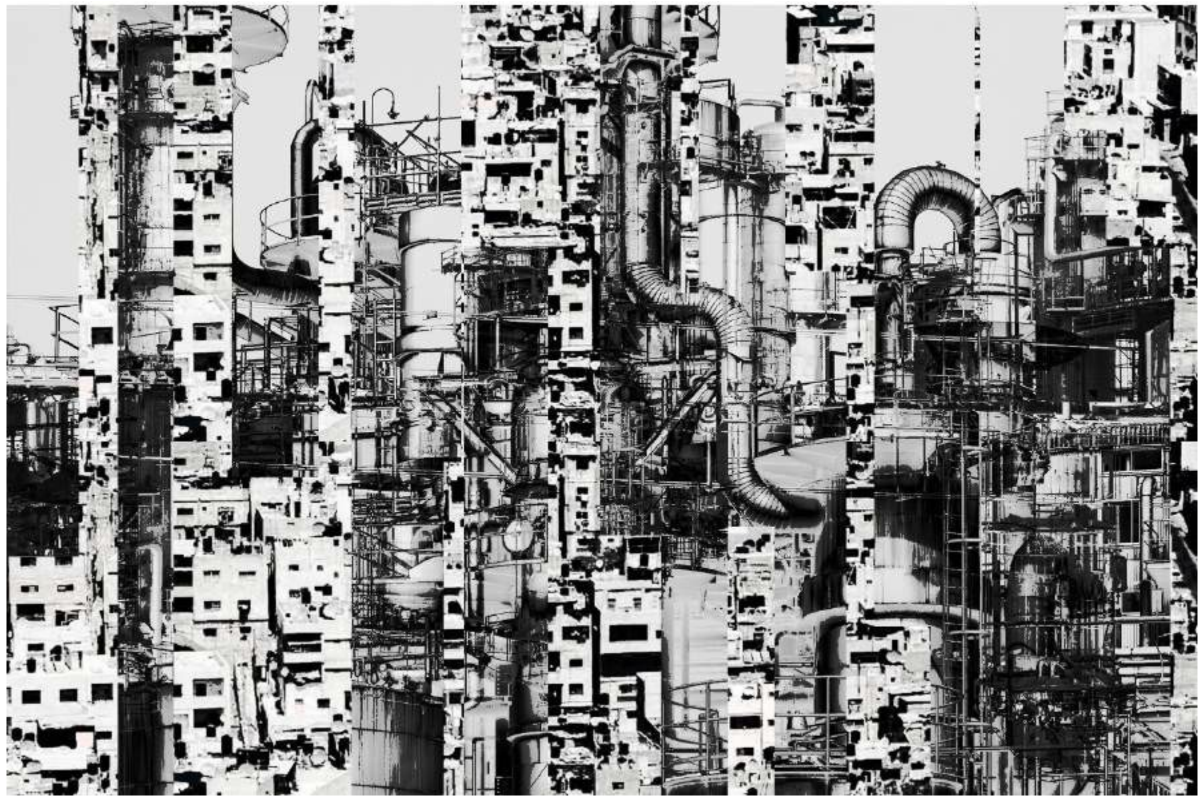
An excerpt from DELEUZE // Gilles Deleuze & Felix Guattari's Holey Space - THE FUNAMBULIST MAGAZINE. (2010). THE FUNAMBULIST MAGAZINE. Retrieved 12 April 2017, from https://thefunambulist.net/philosophy/gilles-deleuze-felix-guattaris-holey-space written by by. Mark Bonta and John Protevi. Edinburgh: Edinburgh University Press, 2004

A thread among post-apartheid accounts of colonial architecture, from the perspective of those who feel disconnected from colonial cities, is the language of a striated powerscape that keeps the colonised as 'other'.

This idea is implied in the works of Gilles Deleuze. Deleuze describes suburban, and state space as characterized by striation and homogeneity. This is different to nomadic space, which is heterogeneous. The two top images, on the next page, are heterogeneous landscapes of productivity. The left image is a refinery and the right image is an urban slum. The visual complexity of the various rhythms and scales of elements align with the rhythms of holey space[1]. They work together forming a similar visual dynamic. Both images convey architectures of consumption and production. However, one is a clear infrastructure that produces a product while the other produces an urban condition of density. The claustrophobia of the elements makes a playground.

I am deeply intrigued by this memory of 'otherness'. As you read you will find various manipulations of this abstract language, and ideas, into literal imagery.

With that stated all the images in the document, unless mentioned, are manipulated and made by the author.



Abstract

This dissertation departs with an enduring interest in the social Milieu and the future projections of the fringes of South African major cities, specifically Cape Town, as urbanization broadens, transforms and makes the edge more complex. This document analyses this phenomenon in Dunoon Township and presents a case for vertical allotment farming in this context. The research, looks at this phenomenon as a narrative of land ownership in its most physical depictions, such as the story of the ownership of land to reap resources as the physical phenomenon of an abandoned quarry. This project acknowledges the danger and light treading around contentious environments, such as townships, which seem to create architecture that aggravates protest and vandalism, but chooses to counteract the pervasive 'headline-ing' of these areas by showing a township, Dunoon, as quotidian. This document does this by engaging with the life around the edge of the oldest quarry in the Durbanville Hills area – Once a source of great benefit and value to its immediate environment – now a fenced off cesspit for crime and superstition.

An empathetic attitude towards considering material developed within the immediate environment to create value, as opposed to sourcing it from outside, is a founding precept for the design endeavour. The project can be described as a process which began by understanding the stagnant water within the basin of the quarry, what systems already exist to bring value to the urban fabric, and how the water can be best used in its mundane life. Beauty, viewed through the lens of this document, is something that brings undeniable usefulness to an area. That is the intervention of a wasted public space with rancid polluted water into clean usable water for a community suffering crippling rates of water shortage and cut offs. It aims to put permaculture ideals into use by routing the stagnant water and making it into a system that consistently cleans itself over time. Routed water embeds a logic that becomes the catalyst for the fulfilment of a bio-inspired future – of which I emphatically advocate.

This dissertation seeks to create an intervention which should encourage a new relationship with water in Dunoon. It is through a gathering of found program; farmers, NGO facilitators, walkers, joggers without tracks, children without playgrounds, women without laundry water tipping points, that the community is brought together in the water world of Dunoon quarry.

Introduction

Currently, public awareness of social and economic inequity has led to protests where people question the traditional notions of power and express a desire to disrupt the status quo within the fringes of Cape Town, specifically in Dunoon. From a theoretical standpoint, this social upheaval is closely linked to a human condition that sees itself directly anchored to a landscape, physically and metaphysically. The protests on the peri-urban fringes of Cape Town, specifically in Dunoon(fig:1), demanding land reform to make way for more housing, reveal the idea of entitlement from the perspective of being rooted to a place. This dissertation echoes the sentiments of Lefebvre[1] which is to say that social revolution in the built environment is rather more productively confronted as an ecological issue rather than a political one.

To add to the broad discussion of making architecture within contentious environments of this nature, this paper aims to initially argue by relating the abstract theoretical ideas of rootedness and ownership as resource ownership and value. This is most clearly shown by the physical phenomenon of quarrying. It considers Dunoon township and the peculiarities of its urbanisation around a quarry, which is perceived to be a wasteful cesspit, as a means of intervention to manage it as a value adding resource to the area. Turning the quarry towards routedness. It does this by preoccupying itself with the irony of the growing scarcity of water and increase in polluted water in large borrowing pits – such as Dunoon's quarry. This project contributes to understanding the ways of approaching large polluted water bodies in water-scarce environments.

1 Lefebvre, H. 1976. *The survival of capitalism: reproduction of the relations of production.* NewYork: St. Martin's Press Lefebvre, H. 2003. *The Urban Revolution.* Minneapolis: University of Minnesota Press.

Fig. 1: *Nearly 1000 protesters make their way across the N1 at Century City towards the station on their way into town demanding their own land from the city.* [1] *Photo: Thomas Holder/EWN. (2016)*

1. Images from Newspaper articles on Dunoon protest riots: Mortlock, Monique. "Dunoon Protesters Hand Over Memorandum To City Of CT".Ewn.co.za. N. p., 2017. Web. http://ewn.co.za/2016/04/08/Dunoon-protesters-hand-over-memorandum-to-City-of-CT

As scholars[2] have said, "Whilst the pro–poor approach adopted in the early post–apartheid era proved to be fiscally unsustainable and unable to deal with macro–forces shaping the city, the urban efficiency and global city agendas for later years are likely to prove unsustainable in their inability to support social cohesion" (Harrison, 2006[3])

This dissertation is marked by an interest in the entrepreneurial Zeitgeist of Dunoon. The research began with an exploration on navigating towards routedness in Dunoon township. Or more clearly explored as shared public space and anarchic ways of making as opposed to agreed space which emphasises the need for ownership.

This paper begins by a background into the dichotomies of Dunoon. It then analyses the quarry, the urbanity around the quarry and the recent or more prominent architectural interventions in the area. It then delves into the condition of the water inside the quarry and what it produces as an intervention material. Consequently, design and research unfold concurrently as explorations of its cleaning are discovered. The research was undertaken through fieldwork investigations on foot, theoretical explorations, interviews, models, drawings and collages.

The final part attempts to engage with, and follow, the design process. Part three, the architectural opportunities presented by the quarry using microalgae and vertical hydroponic farming. The section which follows, part four, describes the process of making the architecture.

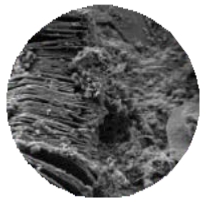
2.These quotes are cited in Bodino, M.(2017). *Architectural Research Addressing Societal Challenges* (F. R. Manuel Couceiro da Costa & J. P. L. S. C. d. Costa Eds.). Netherlands: CRC Press/Balkema.

. Harrison, P. (2006). *On the edge of reason. Planning and urban futures in Africa. Urban Studies*, 43(2): 319–335.

As a picture of the urban future, Lagos is fascinating only if you're able to leave it. After just a few days in the city's slums, it is hard to maintain Koolhaas's intellectual excitement. What he calls 'self organization' is simply collective adaptation to extreme hardship. Traffic pileups lead to 'improvised conditions' because there is no other way for most people in Lagos to scratch out a living than to sell on the street …The impulse to look at an 'apparently burning garbage heap' and see an 'urban phenomenon', and then make it the raw material of an elaborate aesthetic construct, is not so different from the more common impulse not to look at all.

-Packer 2006: 66

Fig. 2: A pile of charred rubbish blocks a busy intersection in Dunoon.
Photo: Barbara Maregele (2016)



Part 1 Reading site

Dunoon - a hybrid 'other' presence

Dunoon is known to be a holding ground or point of transit where many foreigners wait before receiving their passports or visas for permanent residency. Dunoon is a township on the north–west fringe of Cape Town with a growing population resulting from urbanisation. Though decentralised, the land is extremely valuable because of its proximity and connectedness to the CBD. However, the land cannot bring value to the civilians unless they can claim ownership of it—which is quite a feat. In fact, it is believed by the public that, foreign investors investors are buying property in Dunoon and developing Dunoon's original RDP houses into mid–rise accommodation to be rented out for at affordable rates for short stay. Much of this development is happening illegally and informally. Local builders are used, and construction occurs without a single drawing on site[4].

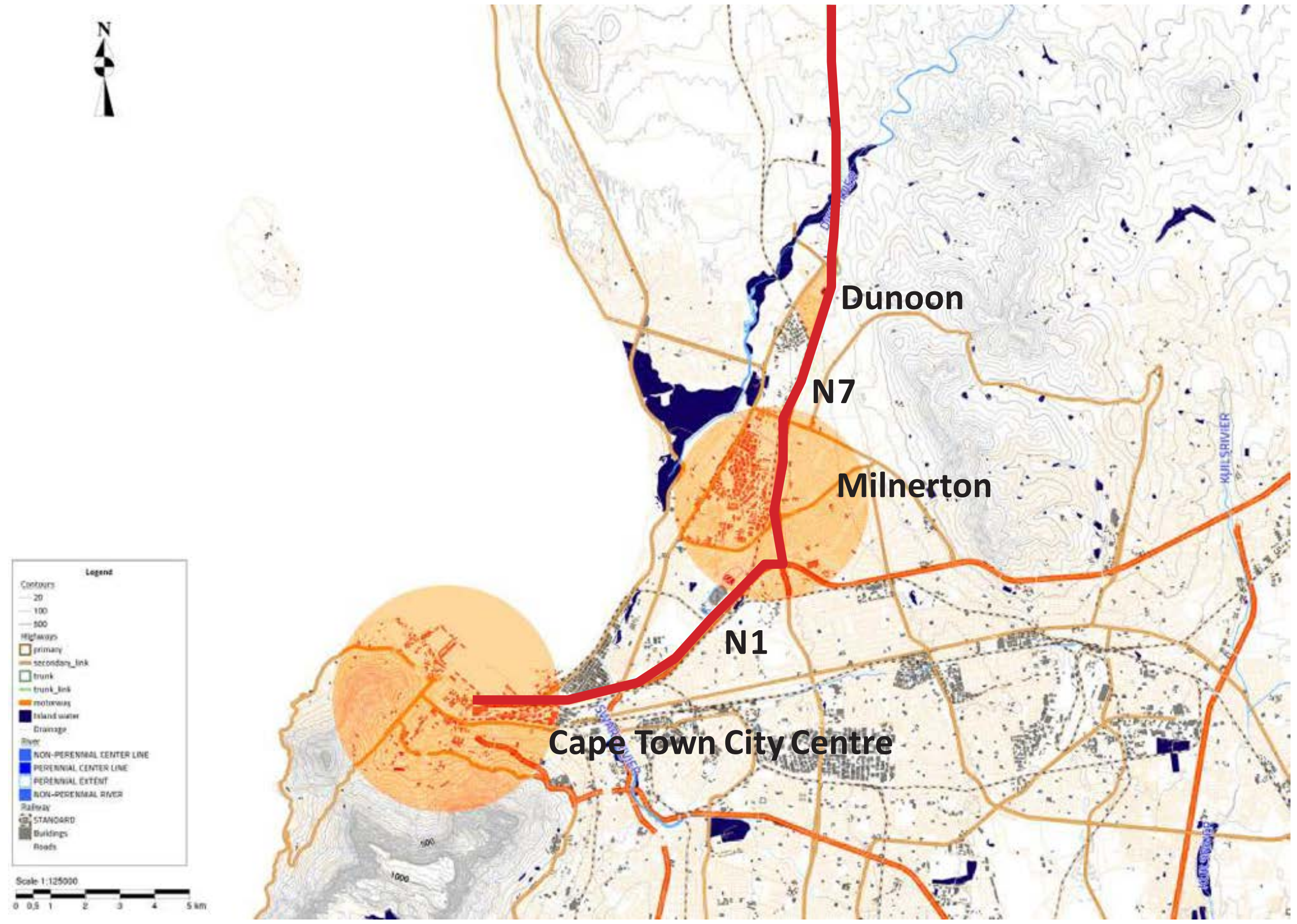


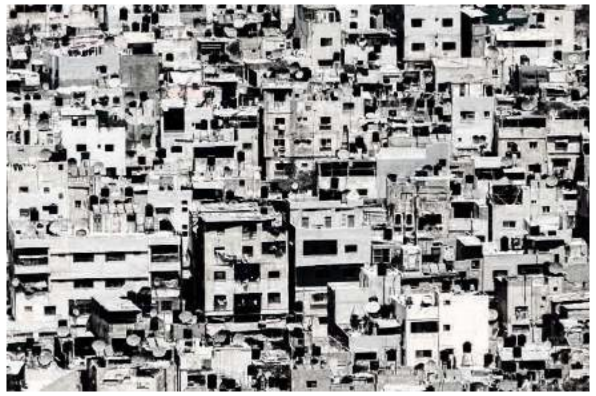
Fig. 3: Map showing routes (major and minor roads), general development and inland open water sources in relation to each other with emphasis on the N7 and nearby suburbs giving work opportunities to Dunoon residents.

4. Insights from informal interviews with Dunoon residents, local construction workers and My Dunoon facilitators.

Dunoon was a township that was a blueprint for the rainbow nation of South Africa as the first planned social housing area after apartheid, with basic services and infrastructure made available to the people that would occupy that area. It has unfortunately become riddled with a history of the worst cases of xenophobic attacks in the Western Cape and one of its most dangerous townships to date. This dissertation preoccupies itself with how the people use its water to shed light on Dunoon, not in the headlines of a newspaper, not as a breeding ground for crime and riots, but in the quotidian. To create an infrastructural architecture that can be assembled out of the ways water is used and wasted in the everyday uses of mundane life.

2014

Source: When in Dunoon – Travel Journals. (2017). Chaoticfront. blogspot.co.za. Retrieved 12April 2017, from https://chaoticfront. blogspot.co.za/2014/11/when-in-dunoon-travel-journals.html



2030

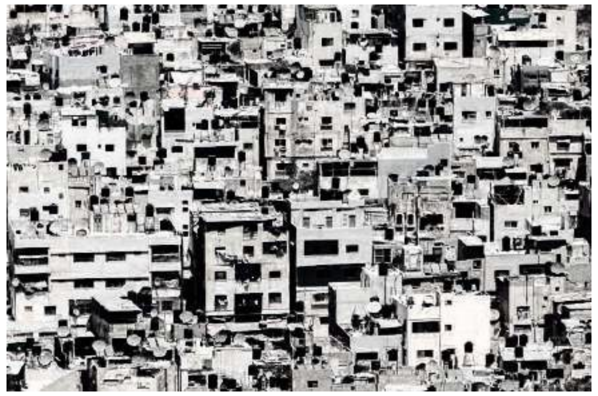
Dunoon's estimated future (based on current illegal building practices)

Source: Learning from a potato – IAAC Blog. (2011).

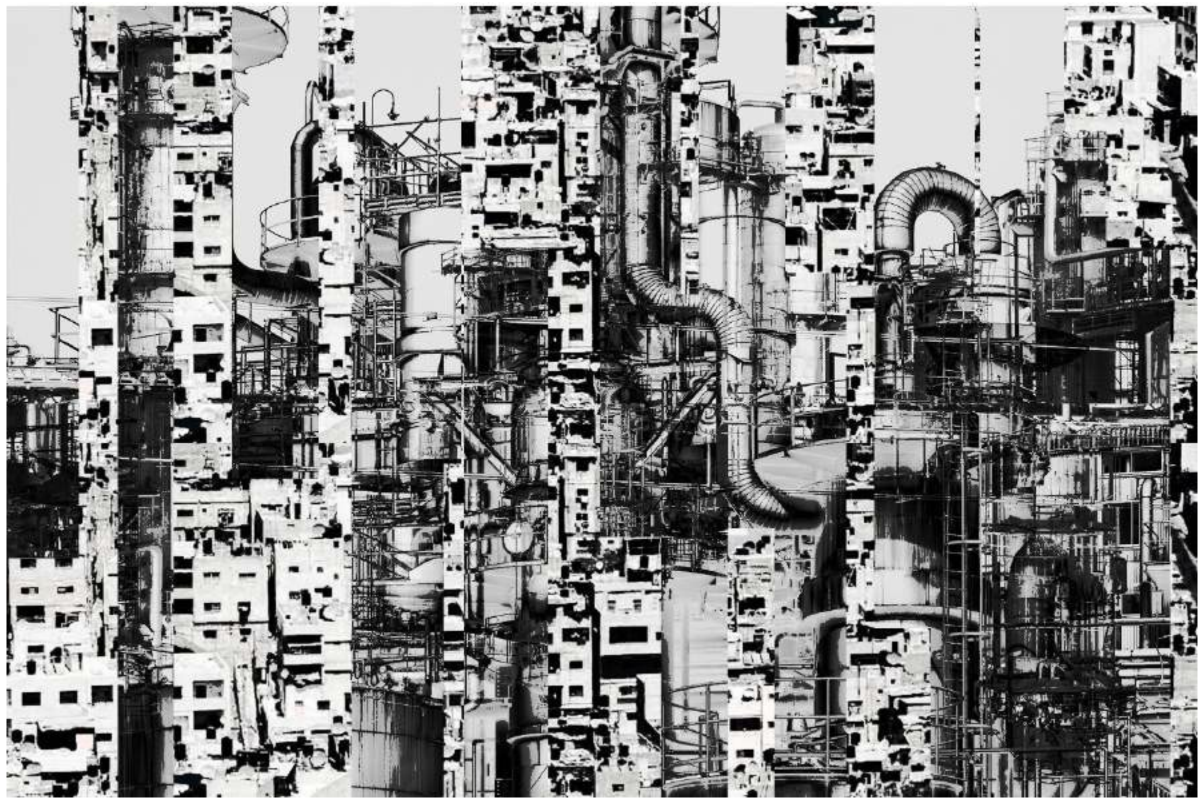
Fig. 4: *Above: A visualisation of Dunoon Township's expected development from shacks to mid-rise rentable residential units.*

Productive-scape

+



Projected future of Dunoon's yetto be built fabric



Beauty in visual complexity found in merging two conventionally unattractive productive scapes

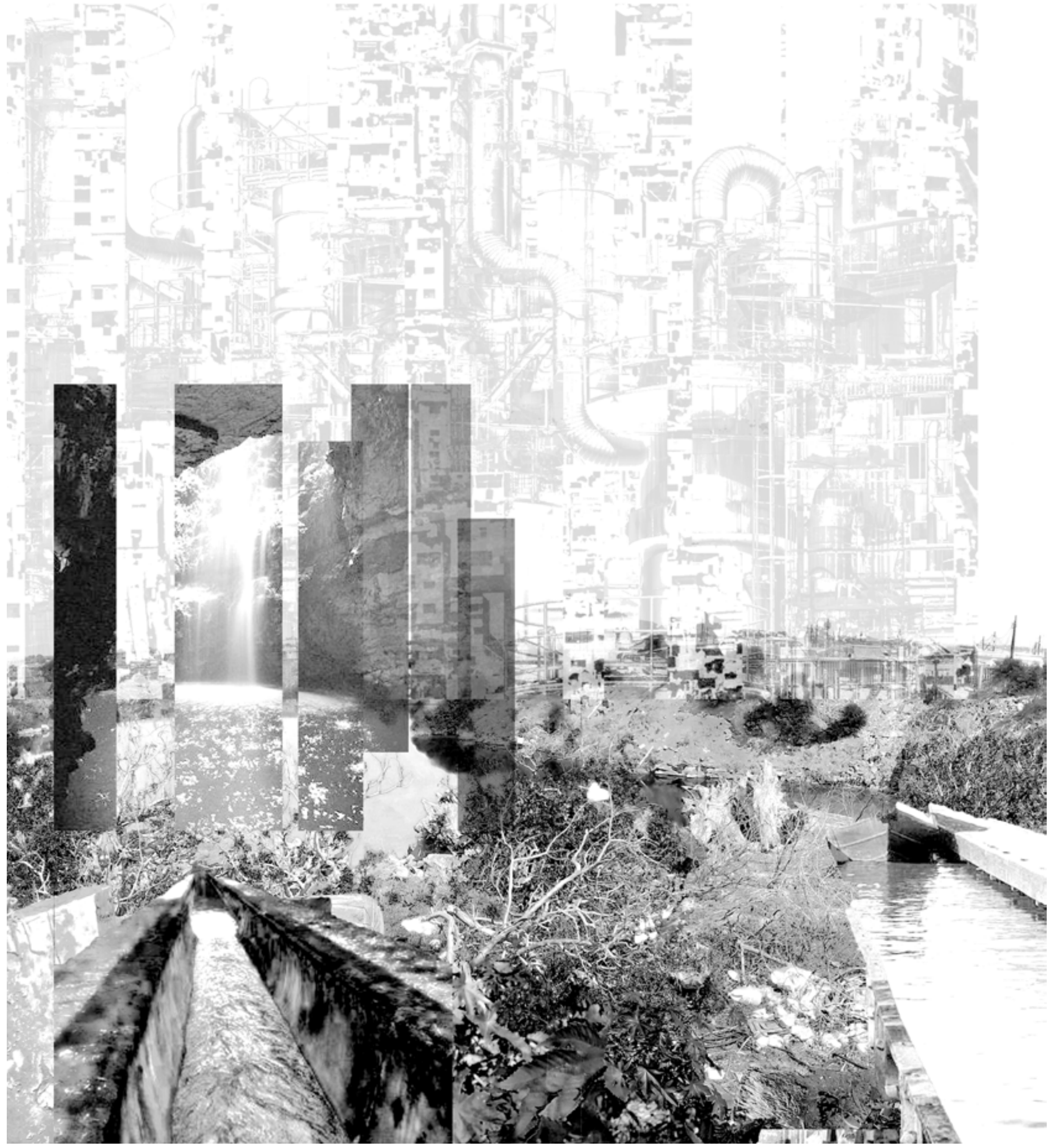


Fig. 5: The beginnings of anoasis

Initial photo collage of how to approach the quarry

Roots make En routes

A loose history of Dunoon's surface mining

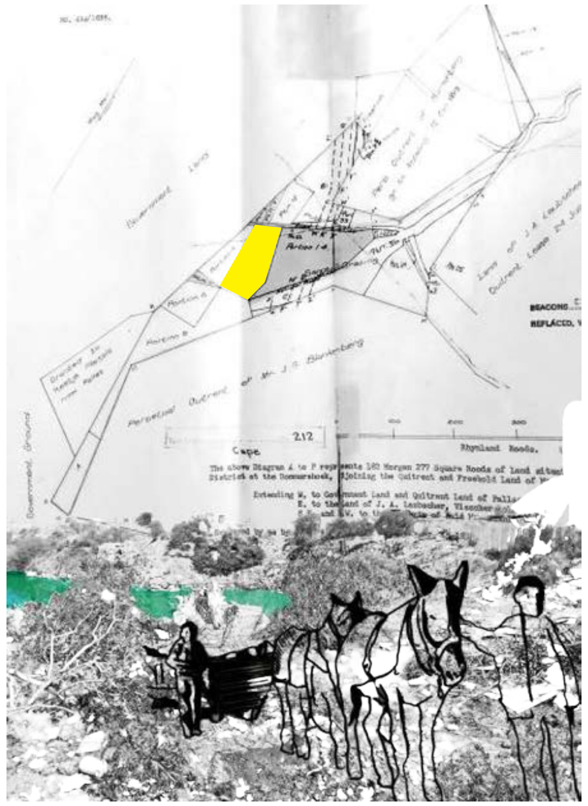


Fig. 6: (Above)1839 surveyor general plan of Farm 212 and (below) a speculative collage of the low-tech tools used from 1839 -1953 to mine Dunoon's road aggregate.

The earliest found records of Dunoon's land ownership date back to 1832 (title deeds). The collection of portions made up Farm 212. The farm was divided according to the most productive purposes for land use such as sand mining on portion 14 and grazing east of it on portion 36. Milnerton PTY LTD owned the farm. By 1838, the quarry had already long been mined. However, the vegetation at the basin suggests it was not entirely bedrock. From GIS imagery, we can deduce that the farm was initially mined for sand, used for development, and then further excavated and used for the road aggregate to make the N7, which is complete in the 1953 imagery.

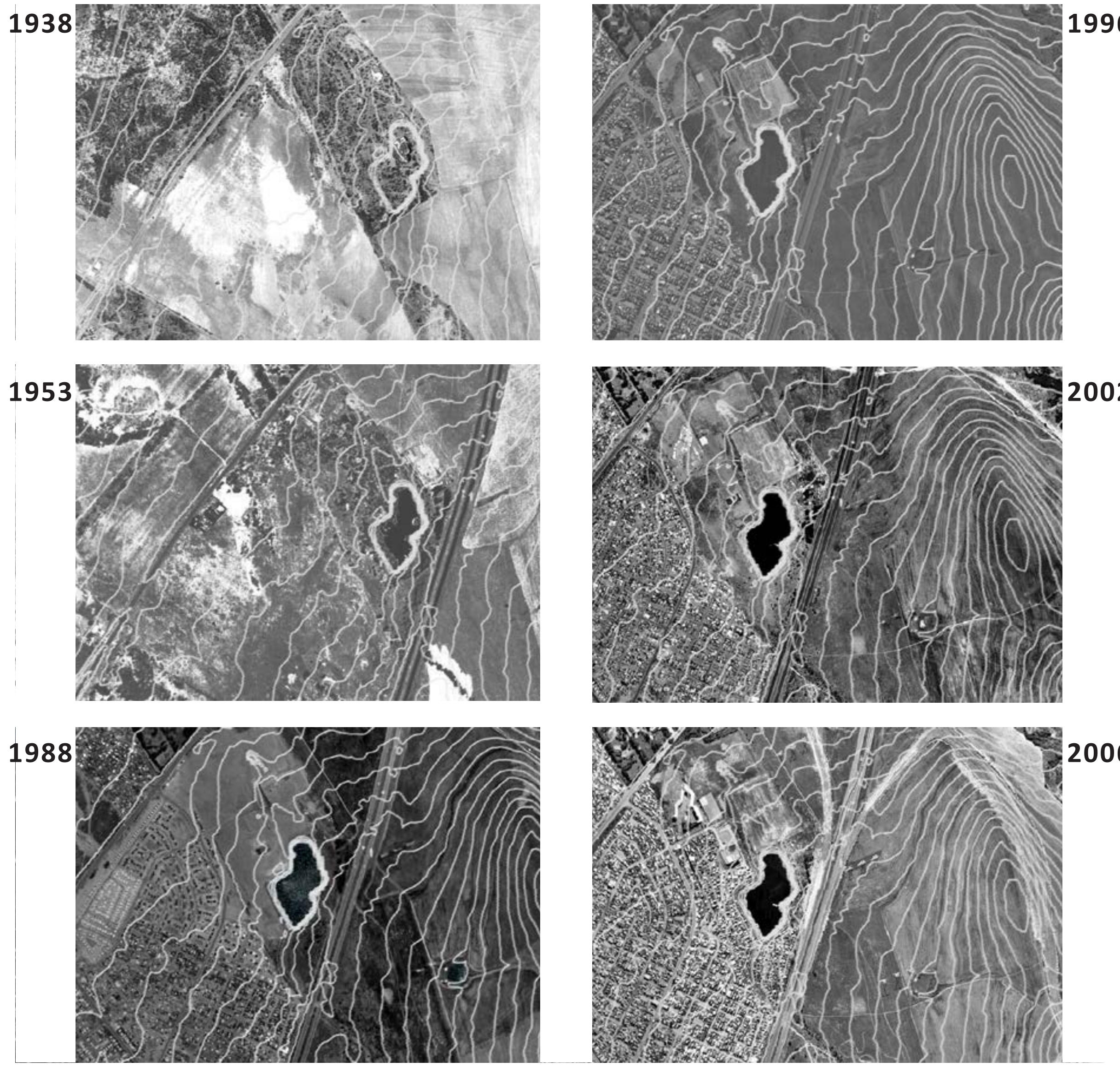


Fig. 7: *Left:1938 to 1988 quarry imagery with contours superseded above it to show quarry in relation to currant position.*

Fig. 8: *Right: Exponential urbanisation once social housing is built where building the fabric is taken into the hands of migrants.*

Information is based on aerial imagery and cadastral data courtesy of City of Cape Town Municipality

Material Benefit

A story of resources and benefit in Dunoon

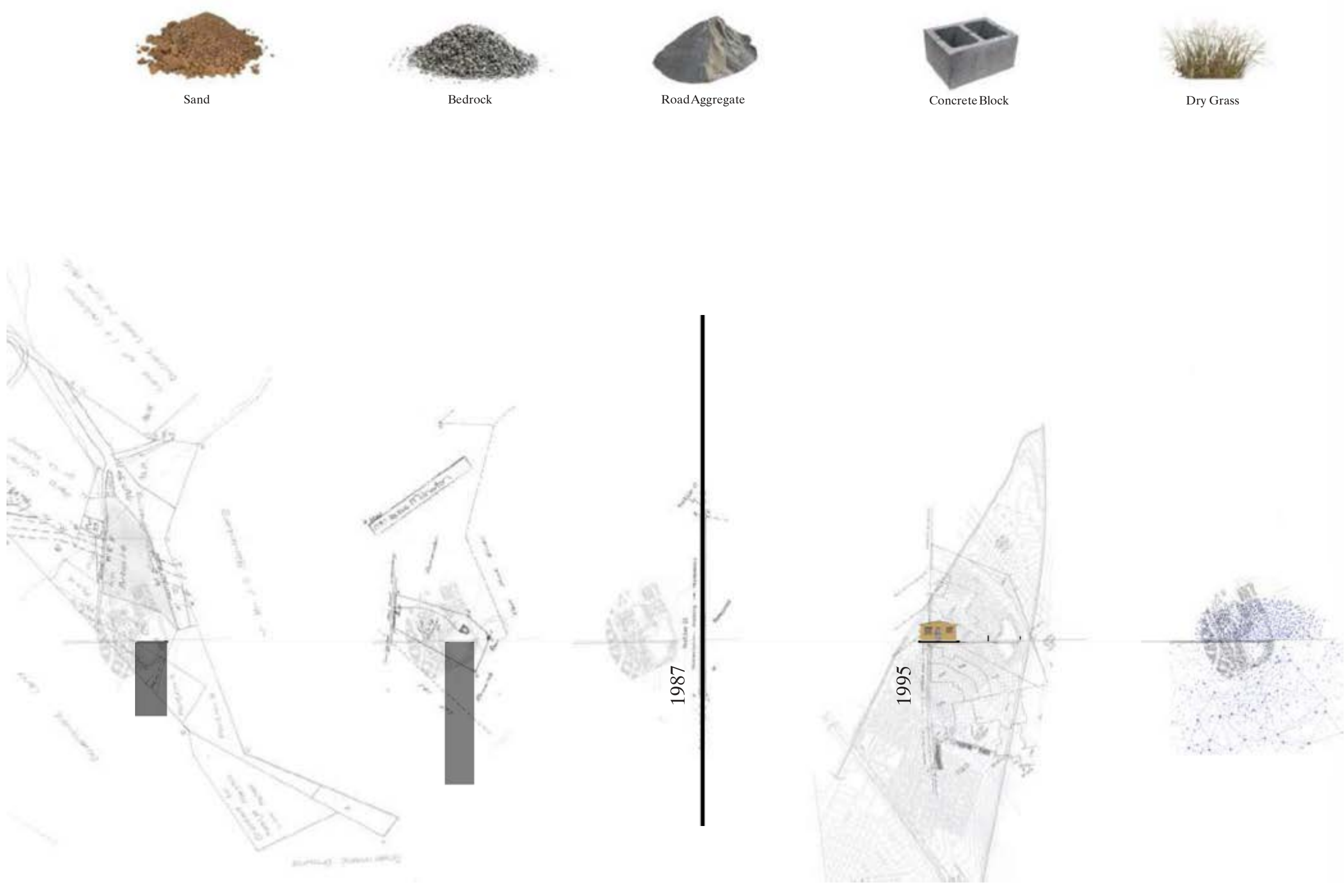


Fig. 9: *A diagrammatic timeline of the materials that benefitted the community of Dunoon as it develops and further urbanises.*

Routed material value

The site embodies a story of material value that migrates towards privileging connectivity. The observation that portions 6, 8, and below were sectioned off for sand mining reveals the material that brought the most benefit to Dunoon at this time was construction sand. This migrated towards road aggregate once the bedrock was mined. The road aggregate was used to make the N7 – connecting Dunoon to Cape Town. The urban value enhancement migrated from materials bound to a place, towards connectivity, routedness. By this mark of modernity, the perception of place on site changed profoundly from that of an autonomous, introverted, and transcendental notion that integrates elements of nature, culture, and man's individual beliefs into a unique ensemble, to one that privileges connectivity with other locations (Mitra šinović 2006: 53).

Subsequently, the items that brought value to Dunoon had migrated towards foreign materials. In 1995, Dunoon's social housing scheme, organised in a cul-de-sac urban typology, was what was valuable for the whole country as it marked a new era in social housing for the new South Africa. Dunoon's proximity to Cape Town, opportunities, and access to a major route made it incredibly practical and sought after. For this reason, this area was quick to be urbanised. During this time, the quarry became walled off. The aftermath of this rapid urbanisation was that much of the urban activity in Dunoon was not monitored. The unfortunate result is the degradation of resources and a greater dependence on imports to improve the value of the landscape.

However, since 2014, value is enhanced through contemporary agricultural practices used by NGOs and subsistence farmers on site. The grass growing on portions 18 and 36 (refer to the 1838 map [27]) is undisturbed due to Telecom cables rendering the land useful to grow produce. Farmers use wild grass near site to make the soil productive for farming. They use polystyrene seed trays to grow their seedlings prior to placing the sprouted seedlings in the ground. They then go on to feed their families with this food and sell the excess, first to neighbours, then on the main road.

2. These portion names do not apply to the current zoning of the site

At a time when Dunoon is facing crippling rates of water scarcity, the greatest value will be found in discovering how large masses of stagnant water, sitting at the basin of these quarries, may be used as a valuable asset to Dunoon – like the sand in 1838.

Fig. 10: Farming allotments north of the quarry. A mixture of subsistence and NGO lead initiatives. (Feb 2015)

Findings

Material Benefit: Dunoon site scale

Materials of value to Dunoon

Dry grass

+

Polystyrene seed tray used by Dunoon farmers

and Alloctho

R8 Fluid

Product

Fig. 11: Dunoon's current agriculture produce that benefits the informal community and farmers

Dunoon as a network of quarries

A fractured water basin

At this time (1838), the quarry had already begun flooding. By the imagery, we can deduce the possibility of two main reasons for the water collection in the quarry. This reasoning will emanate from the fractures in its basin. Fractured rock reveals the story of water seeping in from a shallow Cape flats water table. The fractures would slowly re-regulate the water level after flooding - straining the water from large sediments and containments as an underground river flows from the Durbanville Hills towards the Atlantic Ocean. Alternatively, this may be the collection of rain on an unfractured rock basin. Conversely, based on the observed quarry water level adjacent to the bedrock height and fractured rock microscopy, it's fair to assume the logic that the collection of the quarry water sits on a fractured basin. By this logic the water levels in the newer quarries will naturally be shallower.

Quarry migration vs urbanisation

The Dunoon quarry is the oldest quarry in the area (see map of network of quarries and ownership.). The newer quarries were built farther away from flat land and higher into the Durbanville Hills to avoid disruption from potential urban development. This adheres to contemporary quarry practises.

Fractured-ness and exposure

A collection of the rocks on the different quarry sites and their microscopy reveal different degrees of the rocks' fractured-ness This indicates the ease with which water can pass through the rock to seep into the quarry and reinforces the logic of a fractured water basin in Dunoon's quarry.

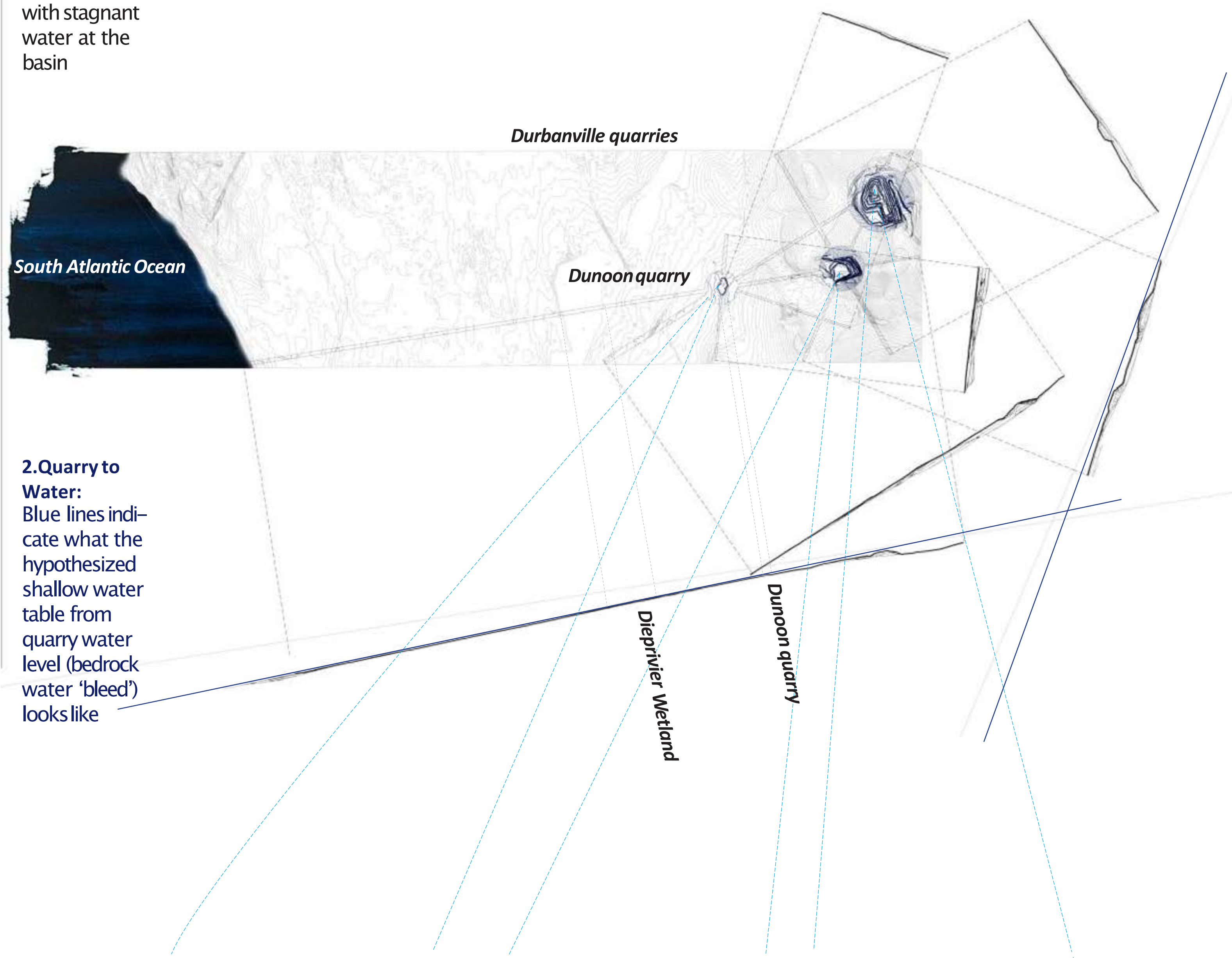
3. The difference between shale and phyllite is that the phyllite may be a slightly harder rock but is not to be confused with the granite intrusion that is found in Table Mountain and further north of this site deeper into the Durbanville hills

The diagram of sections through the landscape and the quarries reveal the quarries' shape in the landscape. The quarries that were all dug into the Malmesbury shale and phyllite bedrock where people have dug until the same depth was reached because of the shallow water table. However, the highest quarry (the most eastern quarry) has the least amount of water at its basin. This means that contemporary mining in that area recognises the practice of creating a smaller basin and mining a wider radius on a higher incline as beneficial.

The microscopy of the Dunoon quarry rock reveals that the fractures have been worsened by time and the elements. This is an interesting discovery considering that road aggregate shale is completely non-reactive (Compton, 2017). There is a stark visual difference in comparison to the smoothness of the younger, immature, lesser exposed shale.

A contour plan of the landscape from the foot of the Durbanville Hills to the South Atlantic Ocean. The landscape is superimposed with sections cutting through the Durbanville Hill network of quarries near Dunoon to reveal the excavations into the landscape. The sections mechanically pivot around the landscape. The section is a machine used to visually articulate the Cape Flats water table.

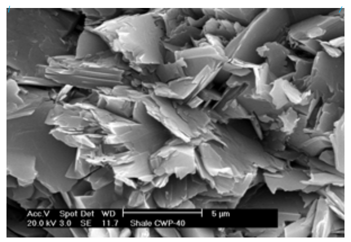
1.Network of quarries: All with stagnant water at the basin



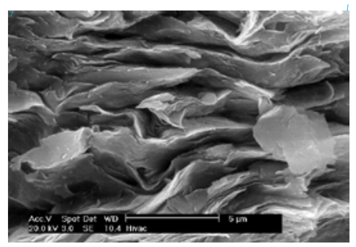
2.Quarry to Water: Blue lines indicate what the hypothesized shallow water table from quarry water level (bedrock water 'bleed') looks like

3.Aged Quarry: Soil fractures to water interaction:

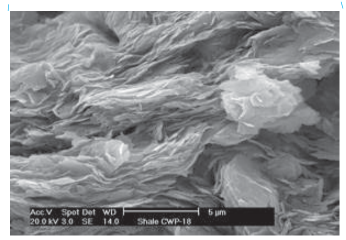
Scanning Electron Microscopy of quarry rock samples



Scanning Electron Microscope image – old shale



Scanning Electron Microscope image – young mature shale



Scanning Electron Microscope image – young (immature) shale

Information is based on aerial imagery and cadastral data courtesy of
City of Cape Town Municipality

Land Ownership of Quarries
Productive Scapes Legend

Fig. 12: Map of network of quarries and ownership.

Blouwberg municipality ownership

1839

Portion 8 of Farm 212 Once owned by Milnerton Pty Ltd, the sand and road aggregate mined from this quarry was used to build the N7.

The bedrock of the quarry is Franctured road aggregate. this means it contains underground water up to 540mm - 870mm depth.

Corobrick

1960

Quarries mining migrated further away from *desired* flat land and into the steeper Tygerberg hills allowing larger quarries to be extracted with less potential for distrubance from urbanisation

Afrisam

1965

Quarry mining migrated further away from *desired* flat land and into the steeper Tygerberg hills allowing larger quarries to be extracted with less potential for distrubance from urbanisation.

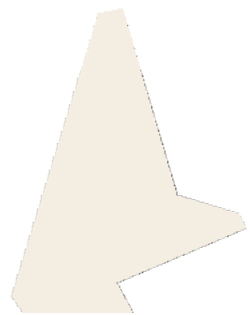
Closer to the granite intrusion, or harder Malmesbury Phyllite, allowing for investement in granite rock mining.

Business Park

1988

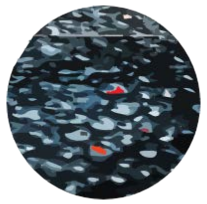
Various construction companies benefit from the economic activity around the productivity of the soil and its surrounding quaries.

Industrial zone



2020...

Zoned and intended to become an industrial zone more construction comapnies own and have invested in the demarcated land to mine the soil which is ideal for concrete production.



Part 2 Studies on the quarry water

Mysteries in the deep

1:10 000 map of Dunoon's erf lines and surface open water courses. Map data courtesy of City of Cape Town

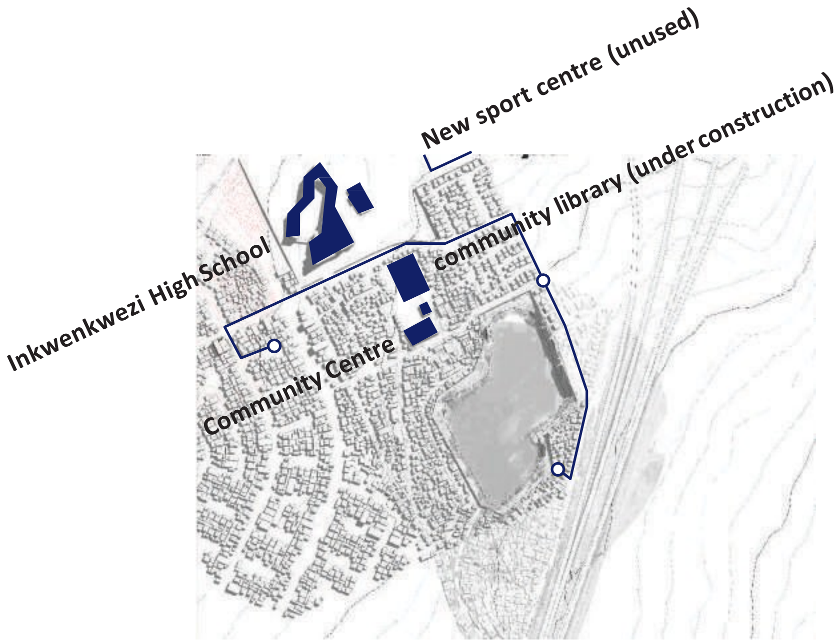
Formal and Informal

Outdated dichotomy?

Castells and Portes state, "There is no clear–cut duality between a formal and an informal sector, but a series of complex interactions that establish distinct relationships between the economy and the state" (Castells et al. 1989). Dunoon's economic sector is heavily influenced by the people's ability to own the land they work (Cooper, 2009). A similar phenomenon is happening not only in the economic sector but also in housing, where formal and informal housing are connected by a series of transactions and the physical border between them is not easy to identify. However, the physical border of added and subtracted value to a space based on its use is clear and becomes more critical the more informal the area becomes. The quarry is clearly an undeveloped resource (amidst a burgeoning precinct) devaluing the area with potential to do the opposite. A clear physical articulation of that idea is the palisade fencing surrounding the periphery.

Site visit 01: Water trail to the Quarry

Dunoon's Formality and informality



These water studies expand on the differences between the formal and informal parts of Dunoon through water infrastructure. The aim is to find roots or clues along the route to the quarry, and along the periphery of the quarry, to understand what the quarry is and what is inside it. It also begins to explore the naturally occurring phenomena around the quarry and how these can be used as resources that bring value to the place in an area where the land cannot be owned.

Dunoon, unfortunately, struggles intensely with water cut offs. New buildings on this side of the township occasionally do not receive water due to a collection of issues. Some of these matters are identified in this surface study of Dunoon's water crisis.

The following pages are deductions from a journey to the, yet to be discovered, quarry. Here we document water and how it is used and discarded in the community.

Root 1: Failed infrastructure

Route to the quarry from a formal neighbourhood part of Dunoon

Notes:

Point of departure

Dunoon's RDP neighbourhoods are typically built in a cul-de-sac urban typology. Neighbours mention pipe bursts are a common occurrence and take months before they receive any professional attention.

Fig. 13: Burst pipe in Dunooncul-de-sac.

Root 2: Failed sustainability

Reused greywater is dumped into stormwater drains that lead water away from productive means.

Notes:

Public perspective from bystander's

NGO's operating in community centres and community members mention their lack of knowledge on sustainable grey-water reuse techniques.

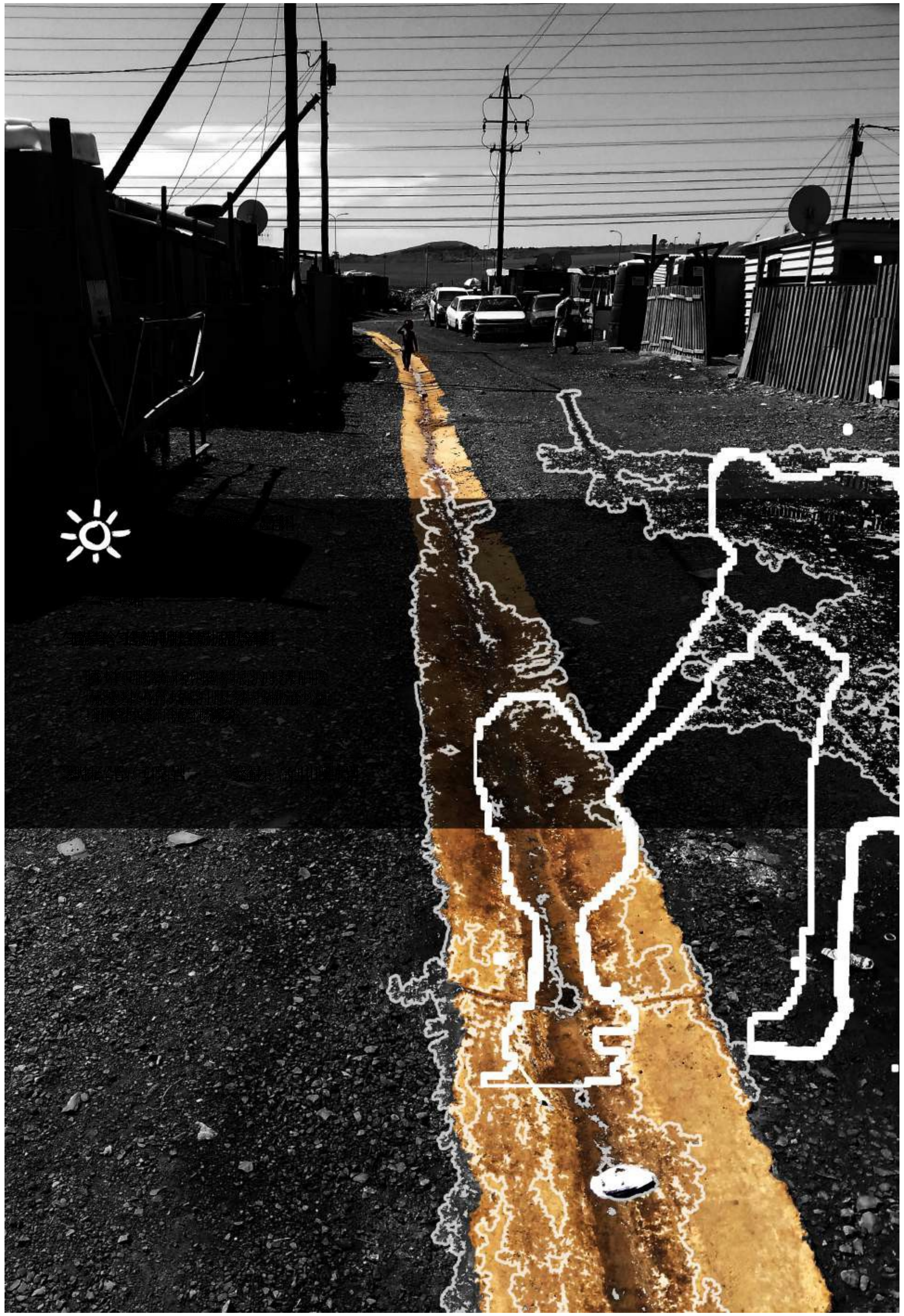


Fig. 14: Stormwater drain use in informal settlements

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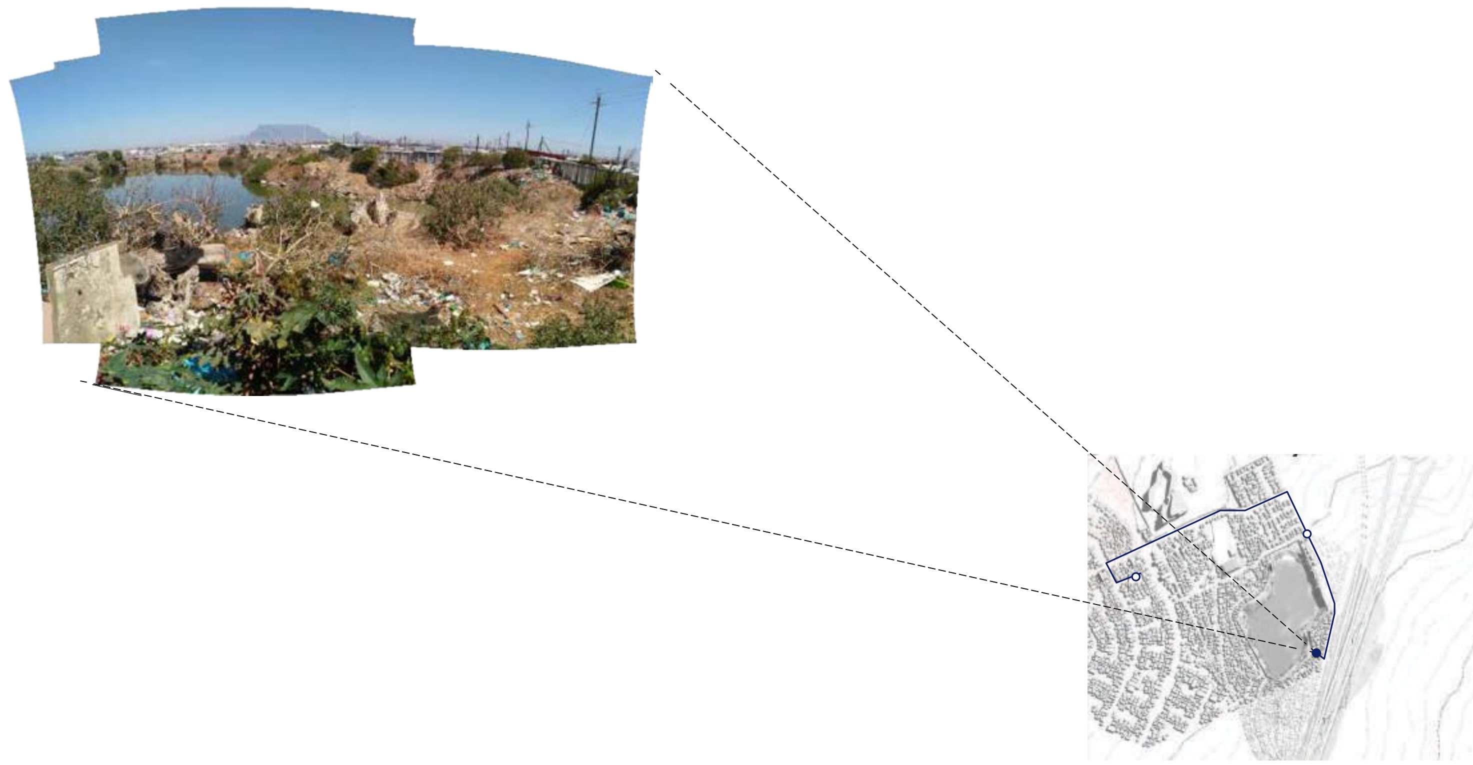
Root 3: Rising water level

Rising quarry water level, should there be a flood, may cause catastrophic health problems for community.



Notes:

Destination

General collection of miscellaneous pollution such as plastic wrappers along the palisade fencing.

Vegetation (Cape Fynbos bush) increases in height nearer to quarry shore.

Fig. 15: Quarry water level rise in winter.

Toxic mysteries in the deep

We can assume a process describing the build–up of pollution from water and soil runoff into the quarry as eutrophication.

Eutrophication refers to the continuous enrichment of waters by the addition of substances that provide for the increasing growth of plant life but not aquatic life. Commonly, this is limited to non–flowing bodies of water such as lakes and reservoirs and not to rivers and smaller streams. The word pollution could be substituted for eutrophication although the emphasis of the word pollution is the addition of substances to water which directly and indirectly interfere with the use of the said water. [36] The word pollution is commonly used regarding flowing water and with lakes and reservoirs, at least when the substances added do not stimulate increased growth of aquatic organisms. Thus, a lake could be polluted with acids and sulphates and debris from mining operations and could be eutrophied with organic wastes from household sewage. [37]

4. (Eutrophication, Introduction, Summary, and Recommendation. G.A. Rohlich. In Eutrophication: Causes, Consequences, Correctives.Proc. Symposium, 1967. National Acad. Sci., Washington, D.C., 661 p. 1969.

Natural eutrophication tends to occur regularly but very slowly, typically over a period of hundreds of years, which is not the case for this quarry. Human activity is generally responsible for rapid eutrophication. As we see in this case, household detergents and wastes are thrown into the quarry from the storm water channels, agricultural land drainage from the farm at the north end of the site, and organic industrial wastes or their decomposition products reach the quarry.

5. Palmer, M. C. (1977). Algae and water pollution, An Illustrated Manual on the Identification, Significance, and Control of Algae in Water Supplies and in Polluted Water, municipal environmental research laboratory office of research and developmental U.S. Environmental protection agency, Cincinnati, Ohio, p 32

In fact, with the combination of raw sewage from unserviced portaloos, reused greywater and soil runoff into the quarry, and other unknown substances, the quarry's water is expected to have a toxic amount of nutrient richness (high salt, acid, phosphorous and nitrous content) that may deem the quarry water more unfit for reuse than black water (black water is still more useful for farming operations because the phosphorous and nitrate content is ideal for plant growth and compost).

Hence the decision to pump and discard the quarry water and restart the slow process of the quarry's refilling through a ground filtration system.

Site visit 02: Quarry as informal suburb

Fig. 16: *Scale 1:500 Map of Dunoon's informal settlements, water mains, and stormwater infrastructure.*

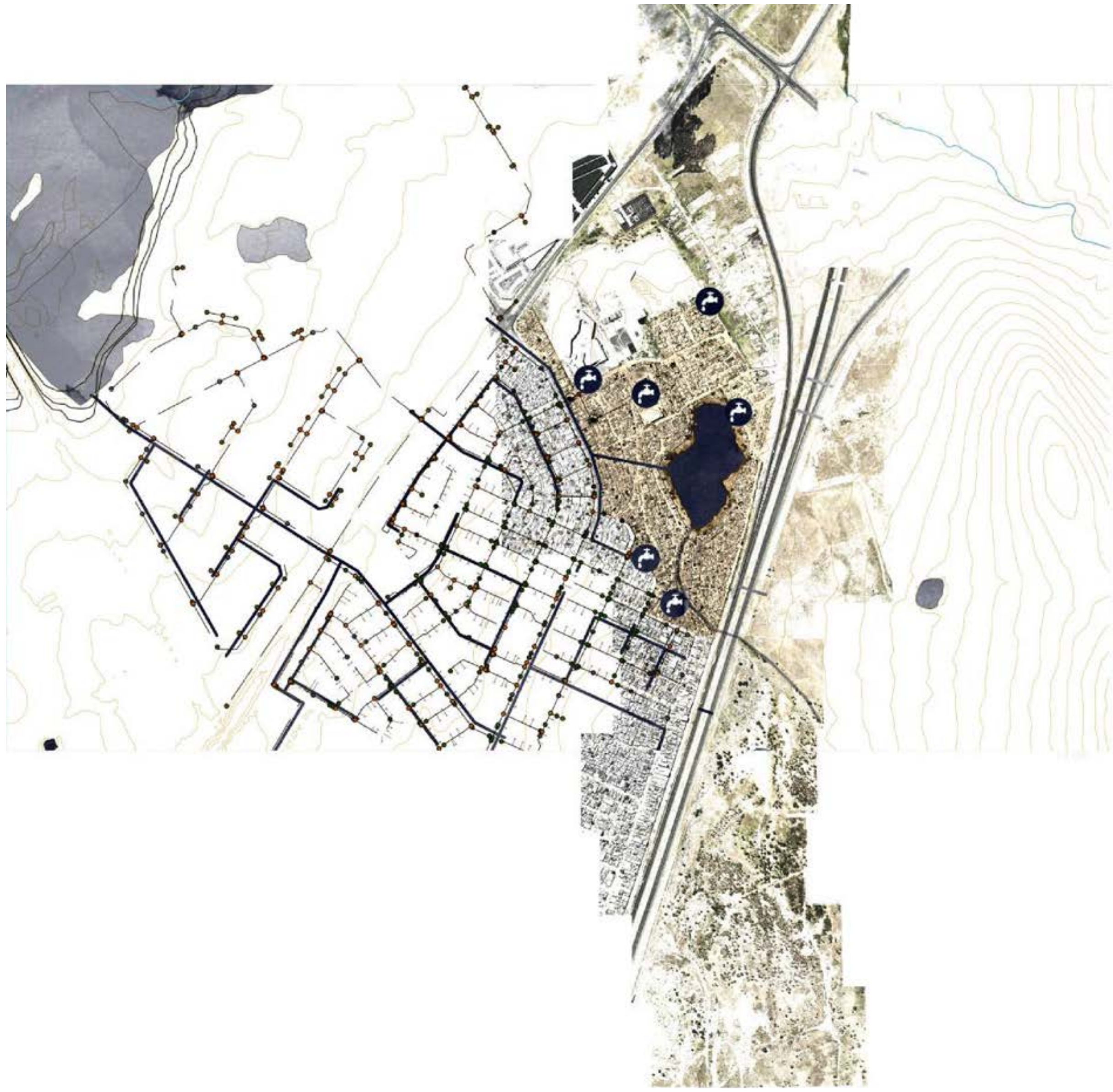


Fig. 17: *Community tap mapping and urban fabric*

Fig. 18: *All taps are used as community taps. However this map shows the public use of the taps in relation to their public use or community enterprise*

Part 3 Microalgae and hydroponics as an intervention technology

Fig. 19: *Photo of Shacks built against quarry fence.* *x*
Photo taken in Dunoon on 29.05.2017

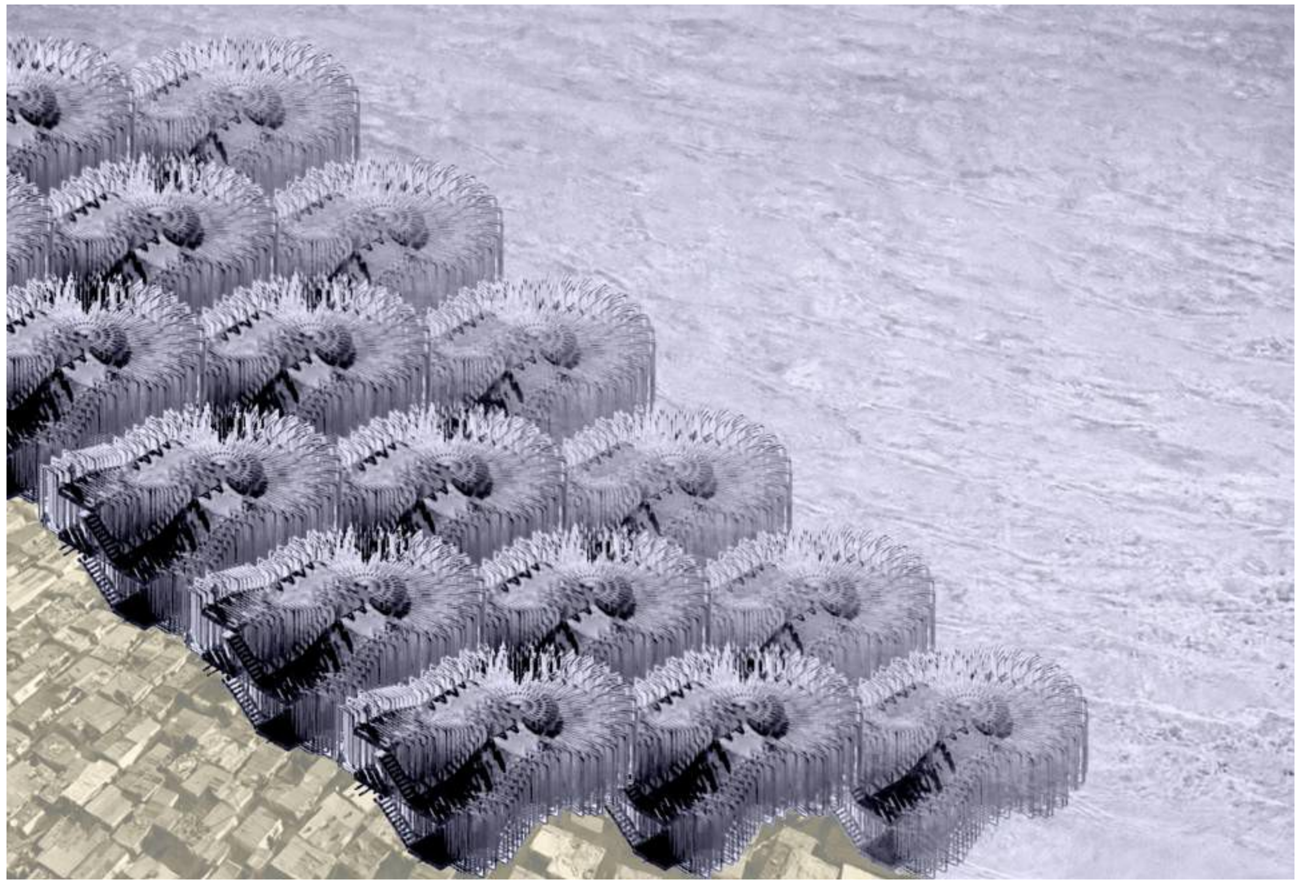
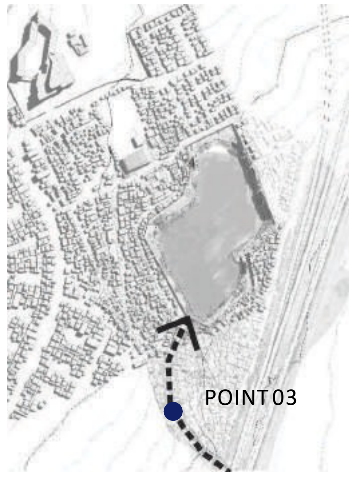


Fig. 20: *Towards clean water: The quarry periphery as a terraced filtration system for clean water.*

Location | Location | sample | samples after a week

Tap water stand by portaloo platform

Grass pond water filled with animal micro-bodies.



Water coming from beneath the N7 (more detergents and soapy water)

Algae rich water

Design Strategies

This project will use what is found within the quarry to enhance the systems currently present in the quarry.

Quarry water findings

The following is a study on the different types of water that run into the quarry from the periphery. This is done to understand and perhaps use what it produces to enhance the area.

After two weeks, all samples (excluding sample 1) were highly populated with green algae. All samples were kept in a controlled environment. Samples 1 and 2 were kept in closed containers (anaerobic). All samples had open container copies (oxygenated).

Algae Energy Production

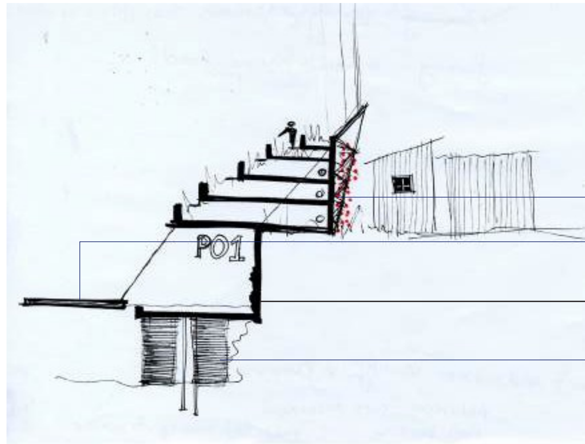
Energy production with micro algae is dependent on the amount of sunlight available. South African UV radiation is ideal for microalgae production (Sierra et al., 2008). This makes algae an ideal intervention material for abandoned quarries in the southern hemisphere.

From stagnant to routed water

In the context of Dunoon's quarry, we know Algae grows in the quarry's stagnant water. The nutrients in that water break down and make an unpleasant smell. Therefore, it is best to keep the algae contained and the water in motion to reap its benefits. If water is stagnant in a closed system it can also become incredibly cold and cause the body to shock (Case study of Brownstone park. (McCandles 2013).

Terracing for oxygen

The quarry water's phosphorous and nitrate contents are excessive because of the greywater runoff and black water spill build-up over time. Phosphorous encourages the growth of algae, which decomposes and feeds the bacteria that consumes oxygen. Algae reduces the oxygen in the water; therefore, this terraced system (see Fig. 21) is intended to put the water into motion to oxygenate the new water entering the system.



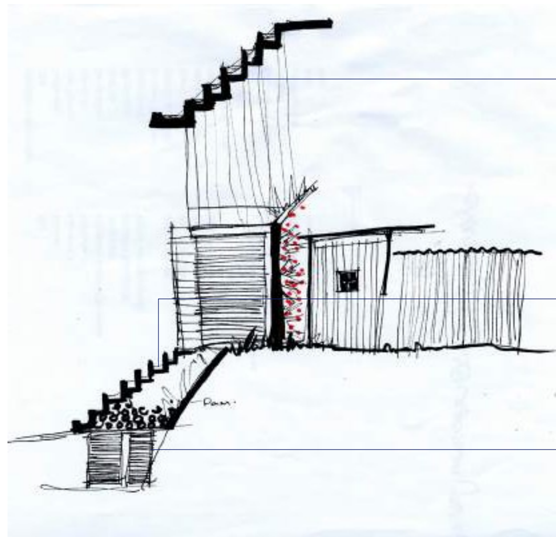
Designing for runoff (from the floor):

Terraced and landscaped park walkway

Shallow natural pre-treatment with plants

Anaerobic digestion

Biomass storage tanks



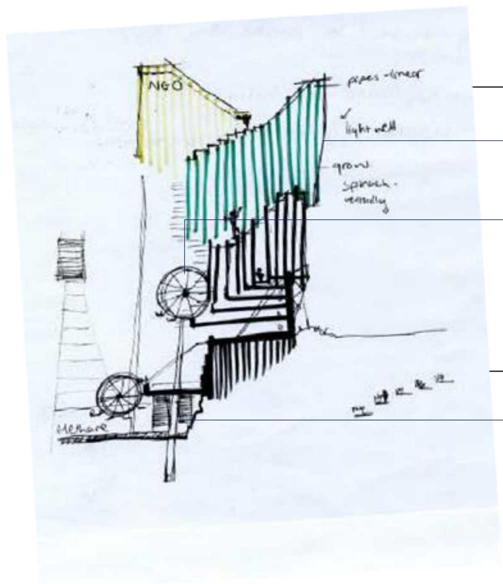
Designing for rain catchment

Accessible terraced Roof garden. pedestrian is lifted above to focus view on Durbanville mountain range. A terraced garden, leaning all plants to gain sunlight and continue the language of the terraced quarry.

Vertical lagooning

Runoff cleaned by sand/reedbed

Biomass storage tanks



Combining the two

Algal pipes for energy harvesting

Hydroponic park

Wind pump's lifting groundwater for human water use (laundry washing)

Terraced and landscaped park walkway

Runoff pre-treated by sand basin

Biomass storage tanks

Fig. 21: *Design development sketches*

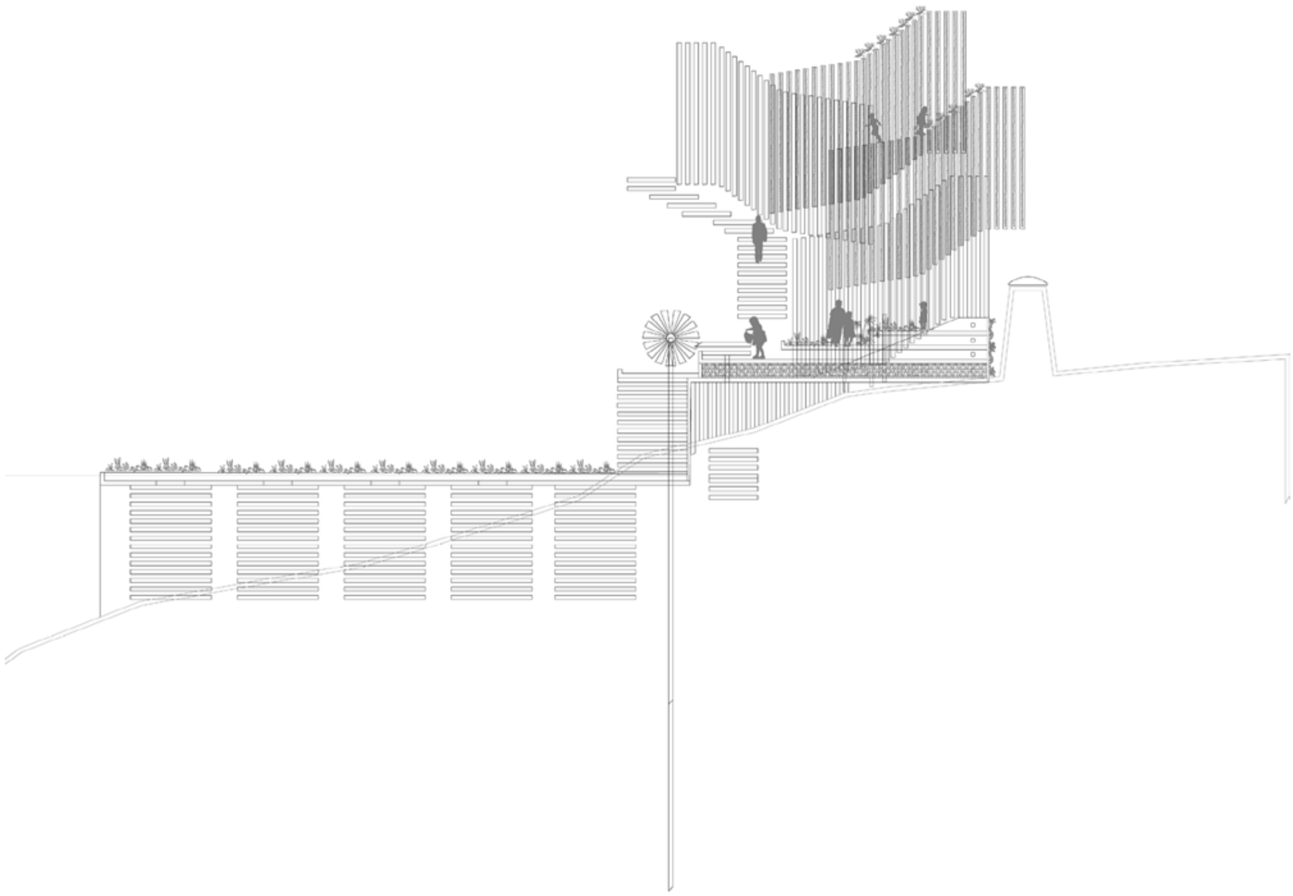


Fig. 22: *Concept section: Linear striations on the periphery*

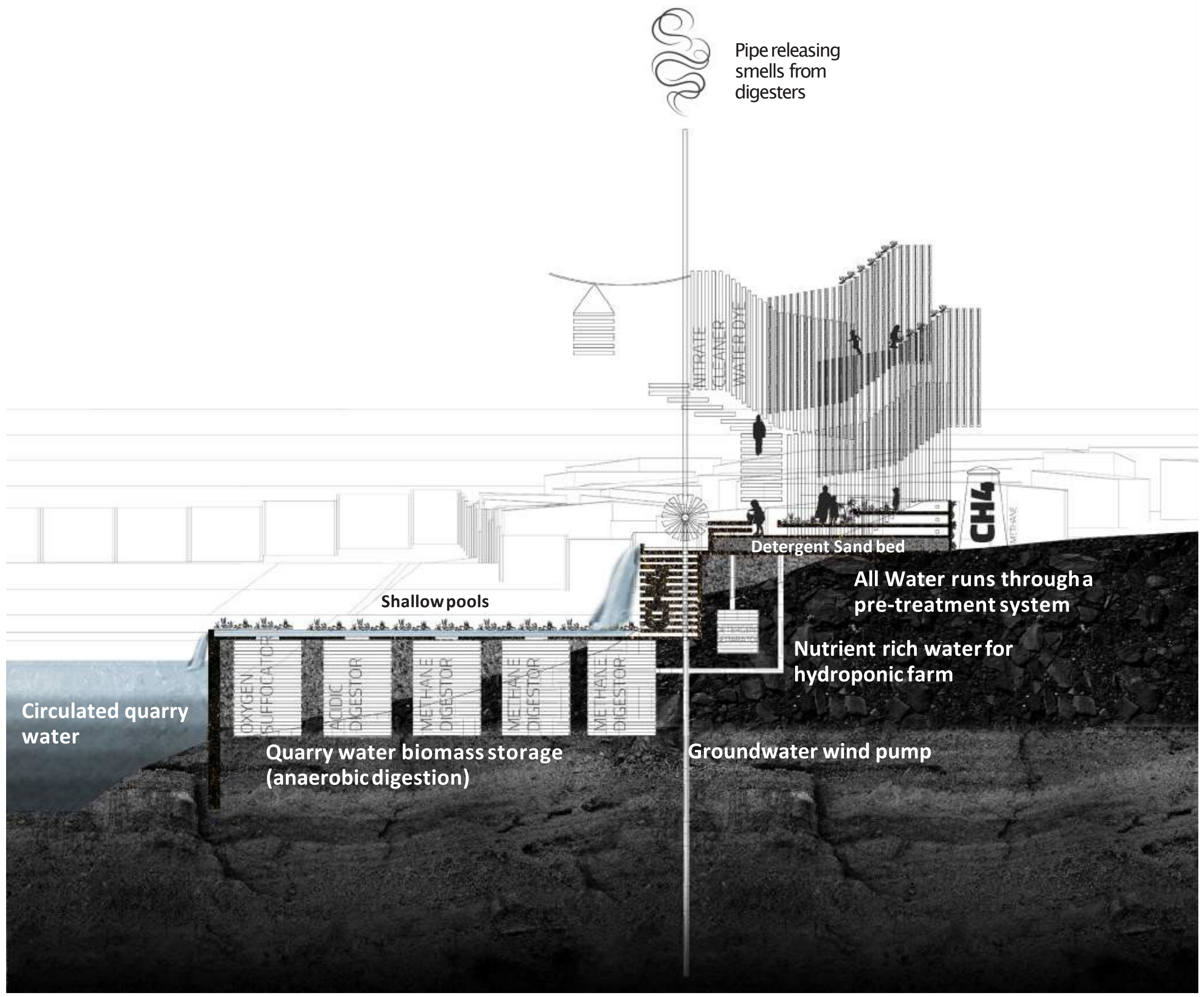
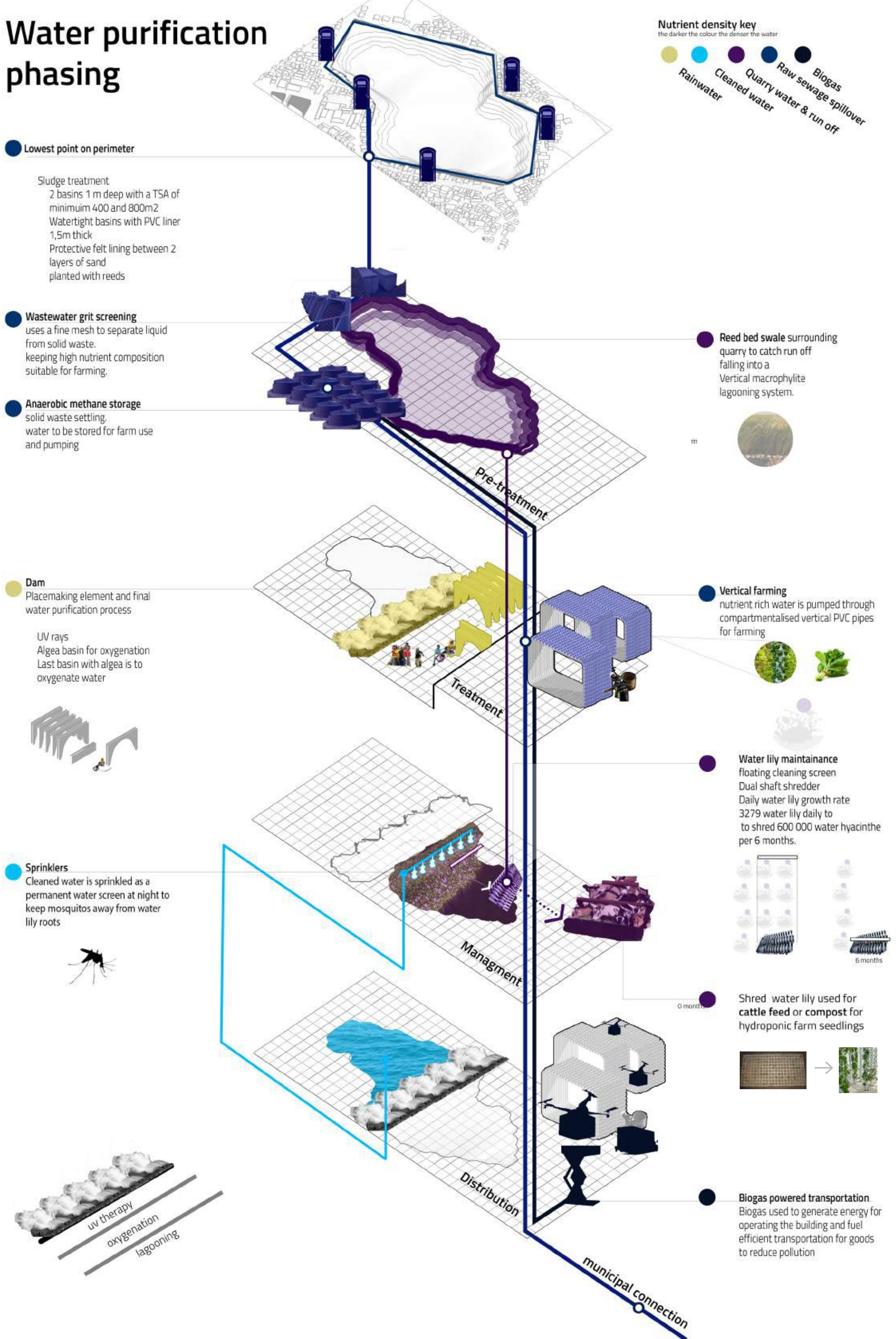
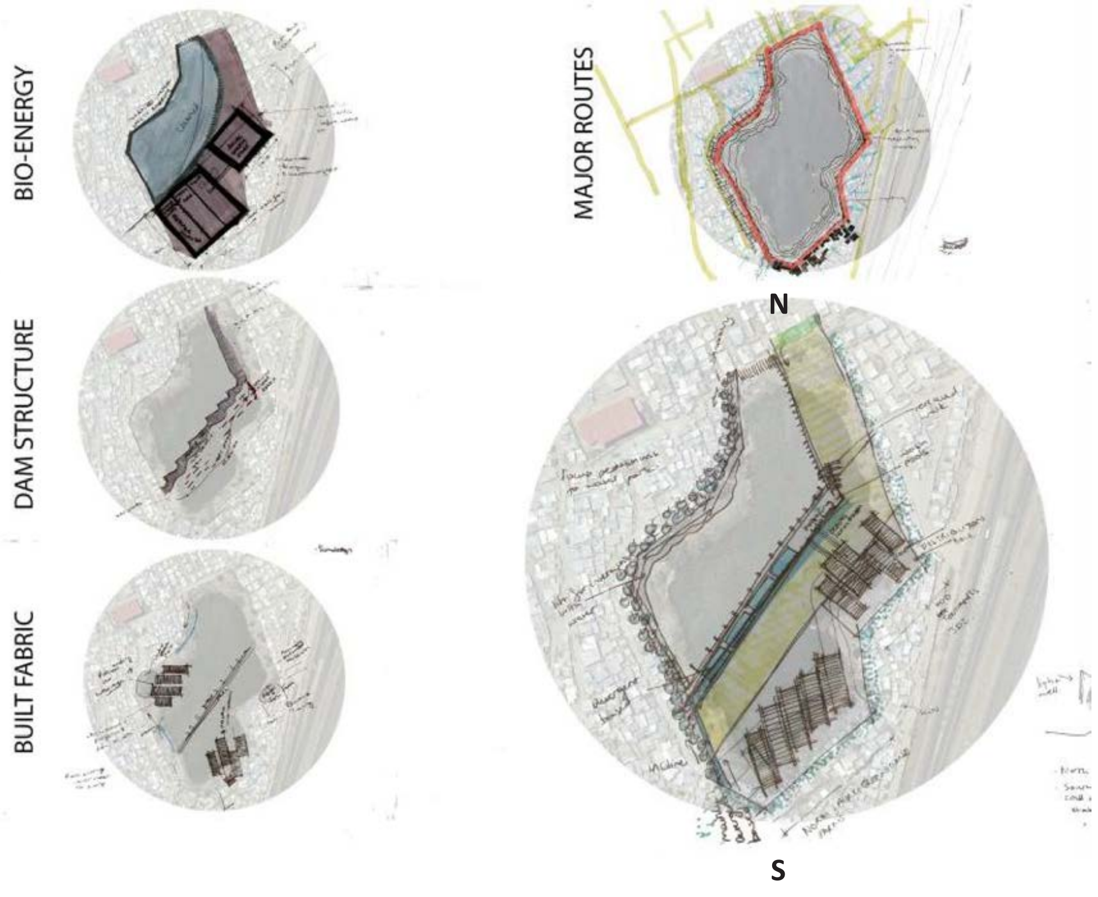


Fig. 23: *Section: Anaerobic water pre-treatment system designed from quarry fence. Image courtesy of author*

Quarry scale design strategy 2: Designing water cleaning systems

This is a diagrammatic scheme considering the relationships between the various systems in the water's cleaning. This planning also considers the ways in which the life cycles around the quarry (such as farming) would begin to interact with strategically placed devices around the site. This planning would need to accommodate the use of many shallow ponds, filled with water lilies, around the periphery of the quarry.

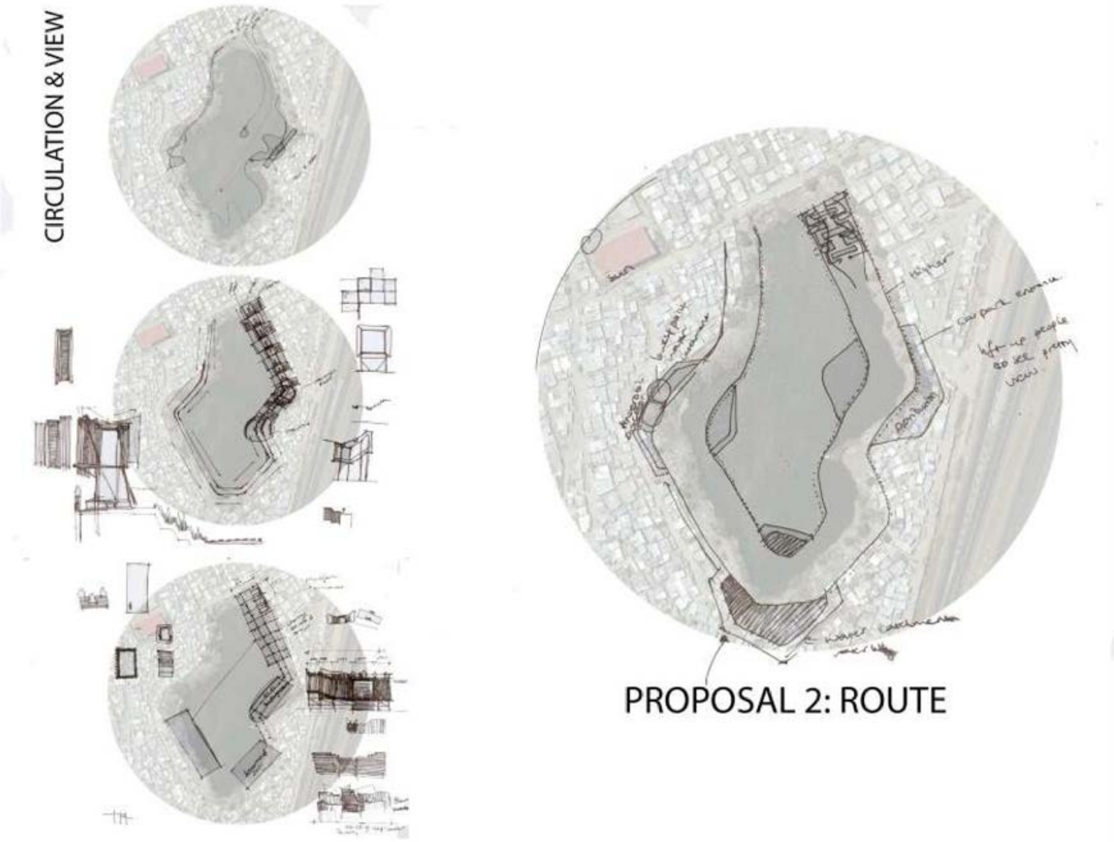




Sketch proposals1

These sketches imagine the quarry as a green space. The pipes are lifted above the roof of the shacks towards the view of the Durbanville hills. The drawings consider the majority of polluted run off to be coming from the south end of the site. Hence, the park is a dam between the south side polluted water, to the north side's cleaned water for swimming.

Fig. 24: *Concept sketch: The beginnings of a pipe aquaculture. Pretreated quarry water is used for hydroponic farming.*



Sketch proposal 2: Park as farm

This proposal imagines a park as the hydroponic system through terracing.

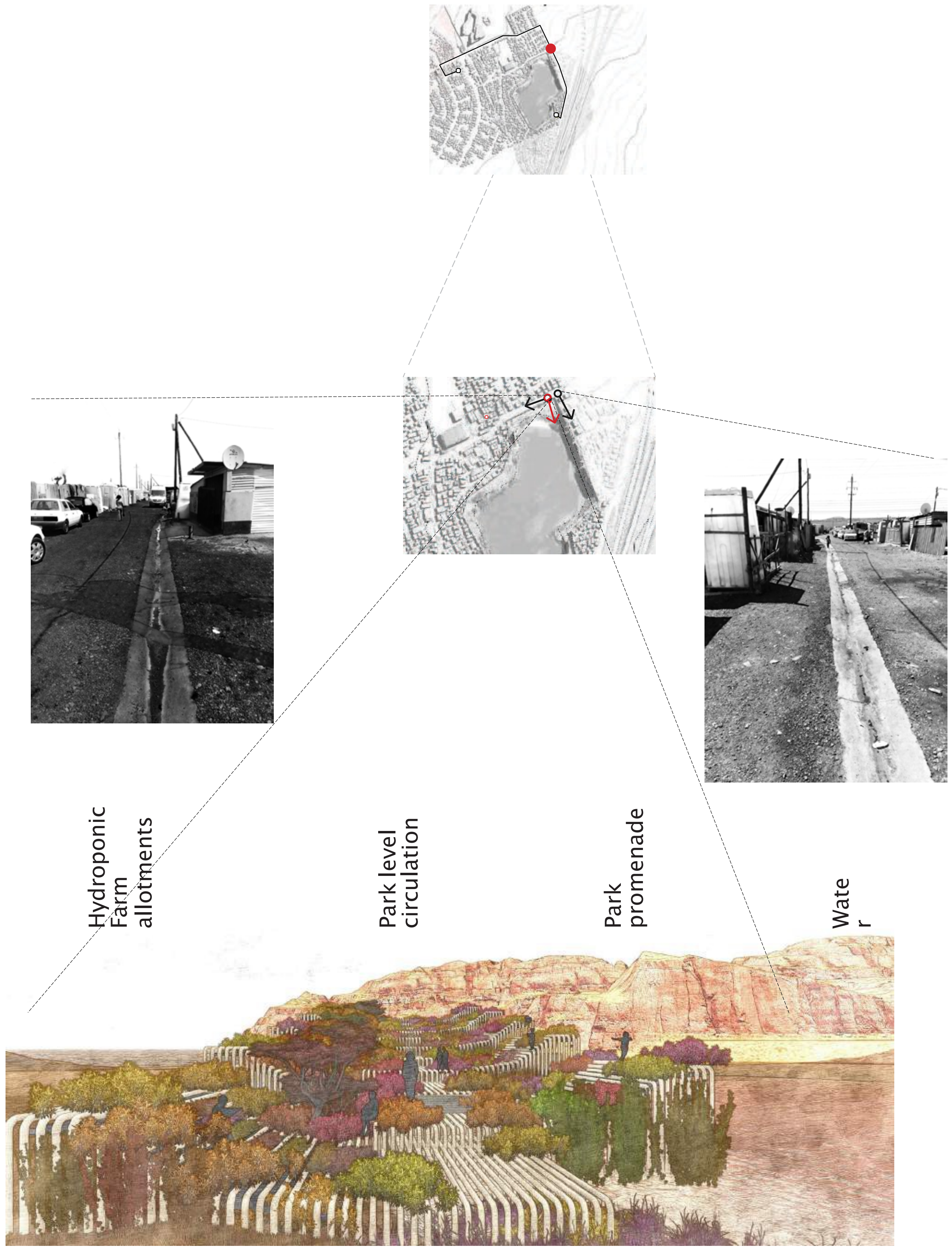
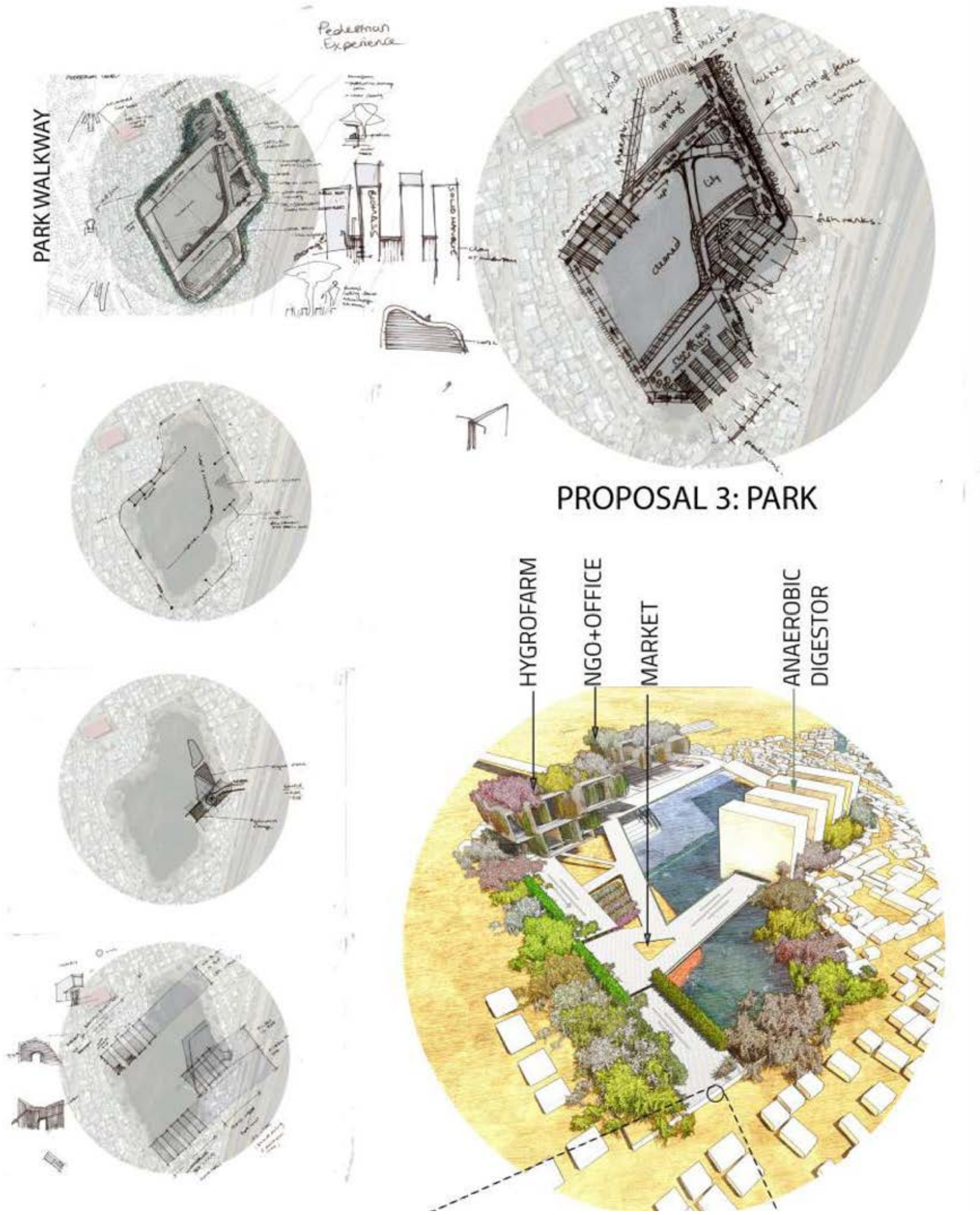
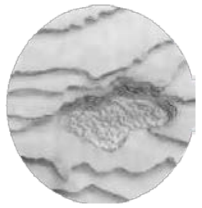


Fig. 25: Viewport projections of the a pipe promenade on entrance to the quarry.

Sketch proposal 3: Shallow pools and park management

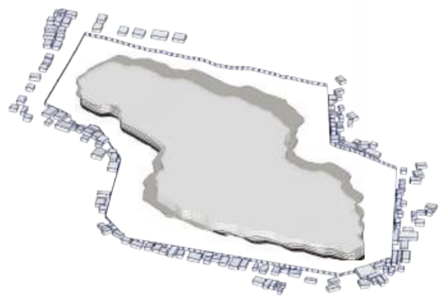
This proposal considers the management of the park by NGO offices. The main critique of this proposal is its use of an institutional language of making to make monumental structures on the site. Therefore, loosing the entrepreneurial, anarchic ways of making that occupy the site currently. The designer should rather design systems that grow with the site.



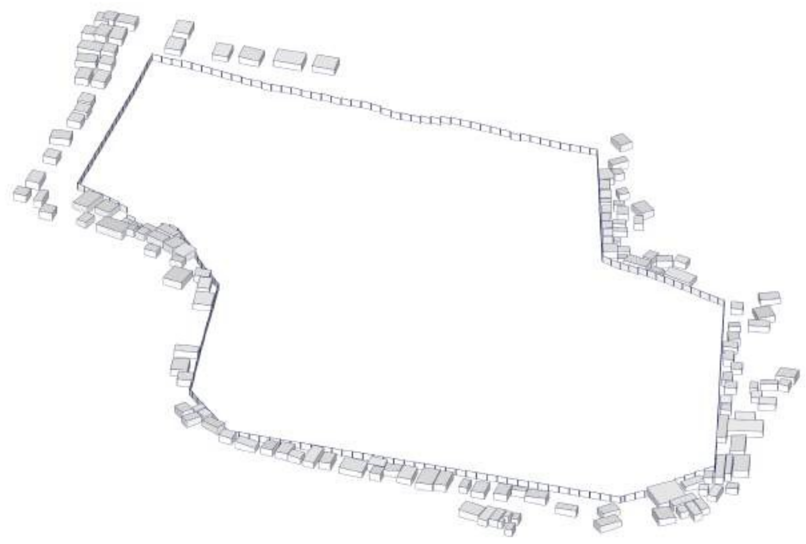


Part 4 Design Development

Quarry study



Due to the large size of the quarry, approaching it requires compartmentalised attention. The first part of the section focuses on the walled–off nature of the quarry. It investigates the periphery to understand how to replace the fence once it is removed to make the quarry an asset. The second part preoccupies itself with the stagnant, polluted water in the quarry and natural methods of cleaning it and putting it into motion. It does this by putting together the knowledge of how water is used on site and culminates into a designed system. It tries to show how this research project appropriates ideas of aquatecture, algae, hydroponic farming, and productivity by beginning to design devices along the perimeter.



Section 01: replacing the fence

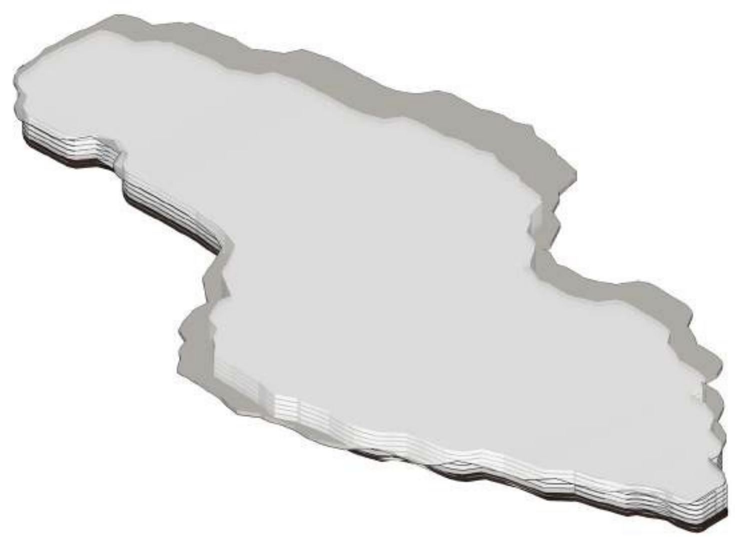
Existing Precast Palisade fencing

quarry perimeter

216 fences – 3100 length

669 600mm

0,67 km



Section 02: Living/moving water

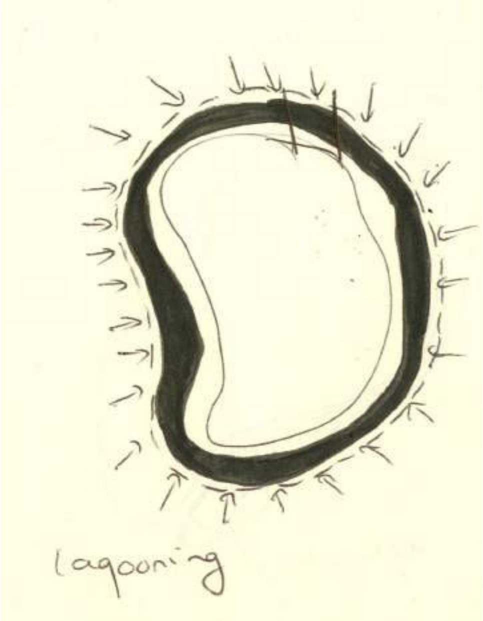
Existing water volume:

143 821 387 386 070, 30 ml^3

143821387386,070 l^3

Replacing the fence

Diagram.1: Pre-treatment: Cleaning water runoff into quarry



Study on the quarry

The best way to control the system is first to control the runoff that would enter the quarry from all angles. Using a primary treatment mechanism through swales and reed beds remove initial contaminants through sand straining and removes turbidity and heavier waste products.

The use of a natural system is the best method in this instance. This is because the decision is based on the maintenance of the system, which will not heavily be dependent on an organisation. The maintenance of aquatic plants, which involves cutting them every six months to maintain a chemical imbalance in the water, is easier and cheaper than having to wait for professional services. Such services are not ideal because this solution is not believed to work best in this area due to the initial infrastructure investigation (refer to page 57). This means designing around the use of plant-friendly environments. This means avoiding a design that incorporates systems that use lots of salts, boron, or chlorine bleach. Therefore, the last basin with algae will be oxygenated for 2 days to kill 95% of the chloroform. Therefore, no chlorine needs to be used.

Diagram.2: Dealing with the bigness and height difference of the quarry: Cutting the quarry in half where main contaminants run in due to landscape contouring.

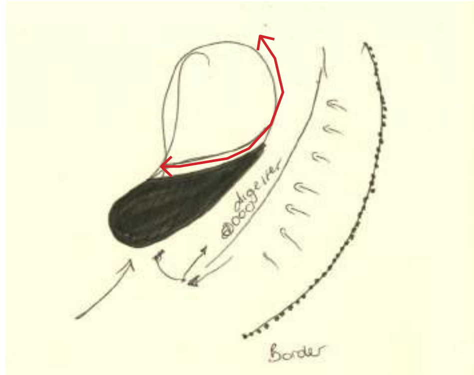


Fig. 26: Vertical macrophylite lagooning facilitates the dilution of wastewater and avoids the risk of unpleasant odours (H. Izembart / B. Le Boudec,2003)

Fig. 27: Sludge cleaned out every ten years (H. Izembart / B. Le Boudec,2003)

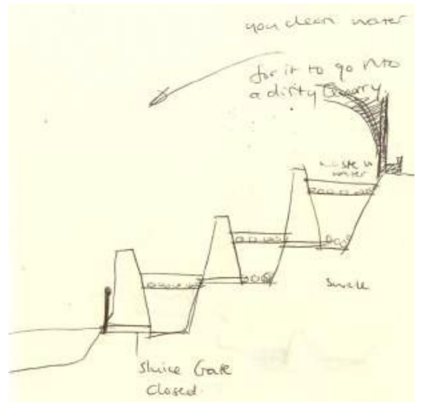


Fig. 28: Design of productive devices that set the water into a cycle that begins to clean and control the quarry water.

Water Devices

Part of managing the quarry's large water is to compartmentalise its treatment. Plants are used mechanically to consume the nutrients of the water runoff from around the site before it runs into the quarry. Undulating curves are designed to manipulate the speed at which the water flows into the quarry. Slower infill means a higher concentration of time in the waters cleaning (see undulating map). The relationship between the architecture and water is that the architecture aims to clean the water at every lower step of 900 mm.

The drawings above show a translation of the water devices used to move water from a source to its destination. The concrete cast wall is recessed to allow water to descend into a shallower sand bed.

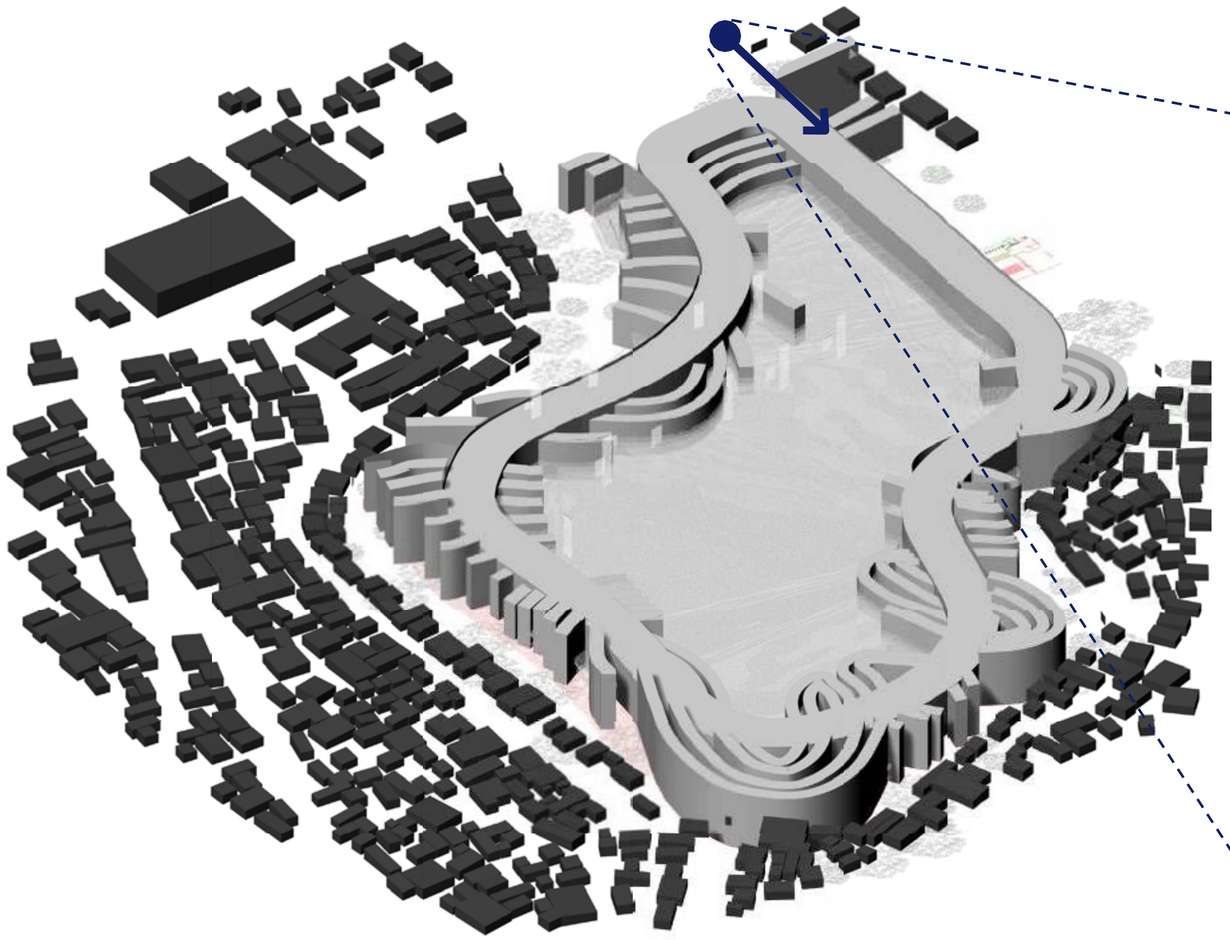


Fig. 29: Undulating filtration system cleans the water as it seeps into the quarry.

Currently Dunoon farmers sell produce on the side of Potsdam Road (the main road running through Dunoon)

Entrance to site

DIY Construction of undulating curves

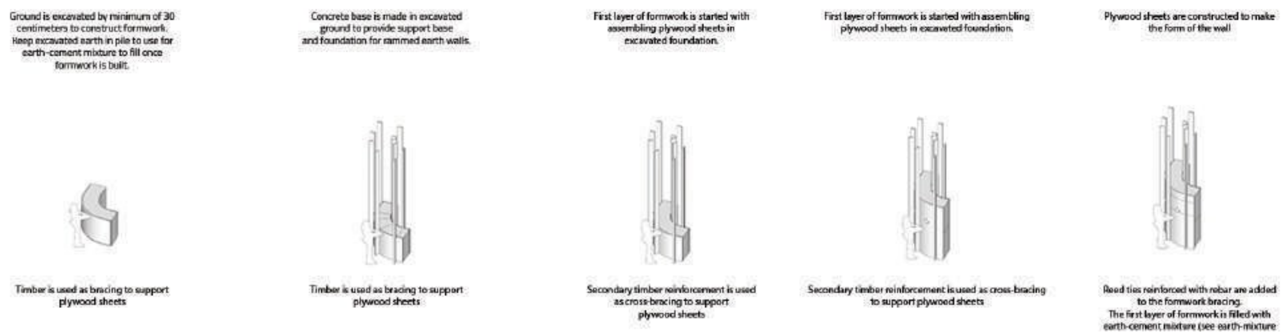


Fig. 30: ***Sectional programmatic collage of the vertical allotment farm and the park***

The fine sheet of water easing through the gabions of quarry rock, the single stream of water falling as a slender slither along a recess at the edge of the slithering wall to the crescendo and drama of cascades that can create a significant sound which obscures the noise of distant urbantraffic, and the visual effect of turbulent falling water creating a rising misty spray, which, itself, refracts light. The quarry water is fed into the vertical hydroponic farms that drip the water back into the reed beds.

Scaffolding for future development (more vertical farms as allotments grow and Dunoon urbanises)

Terraced laundry water tipping area

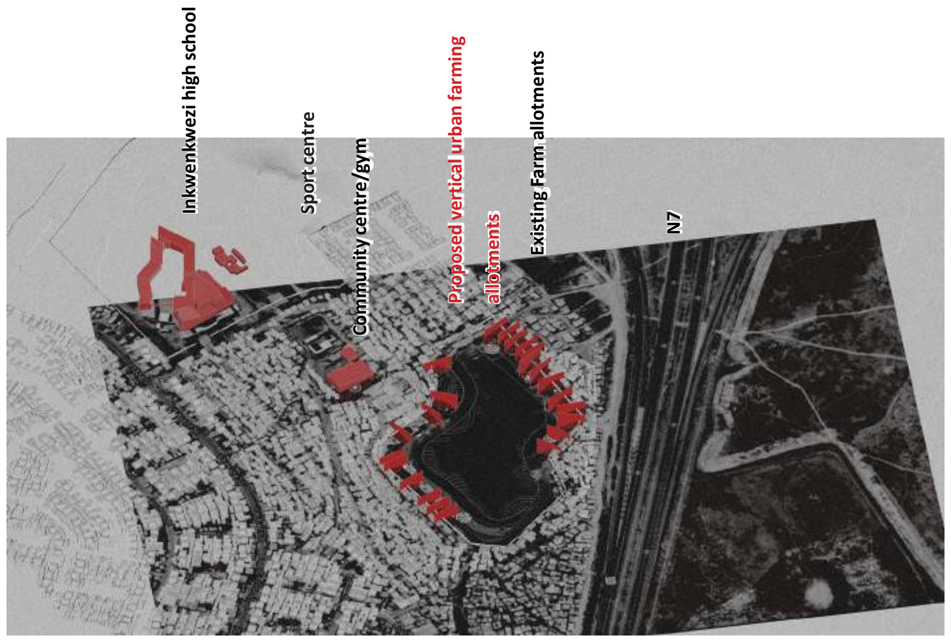
Produce market along park walkway

Bio-digester storage

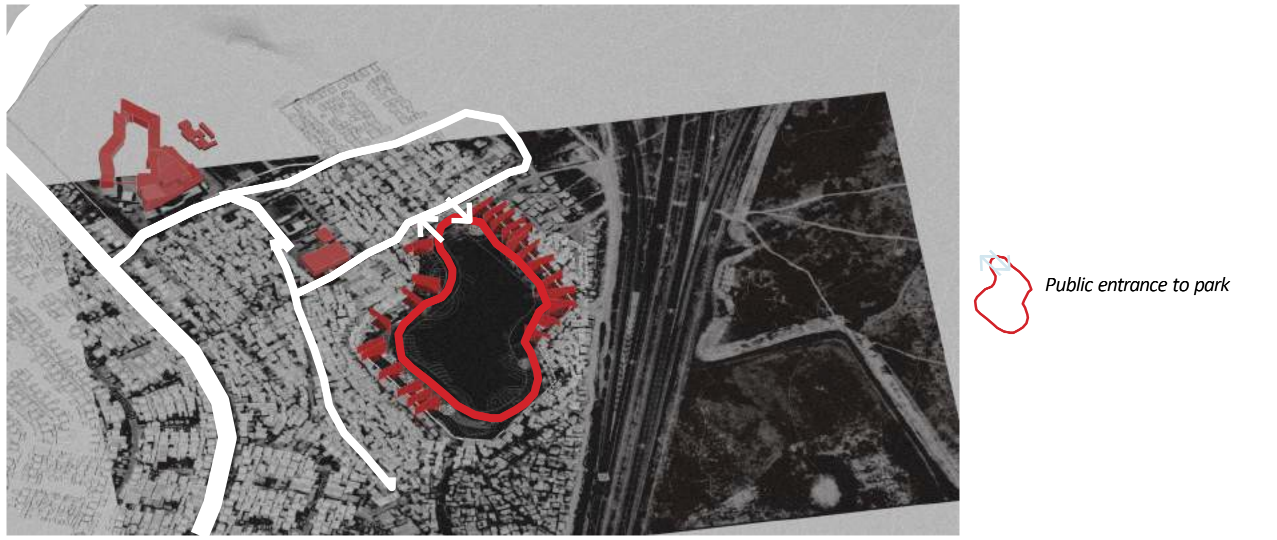
New municipal connection point

Urban Scale

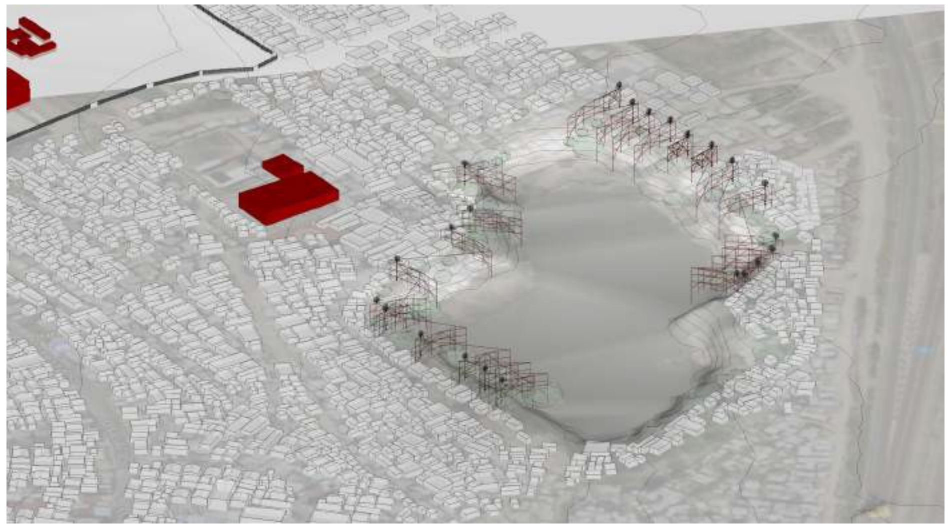
The design process can be separated into major two parts. The water and the quarry. This consequently makes the vertical hydroponic farm and park vertical lagooning system respectively. This section will show, through diagrams, the process of the two parts, and when they are suggested to be made, from anurban scale.



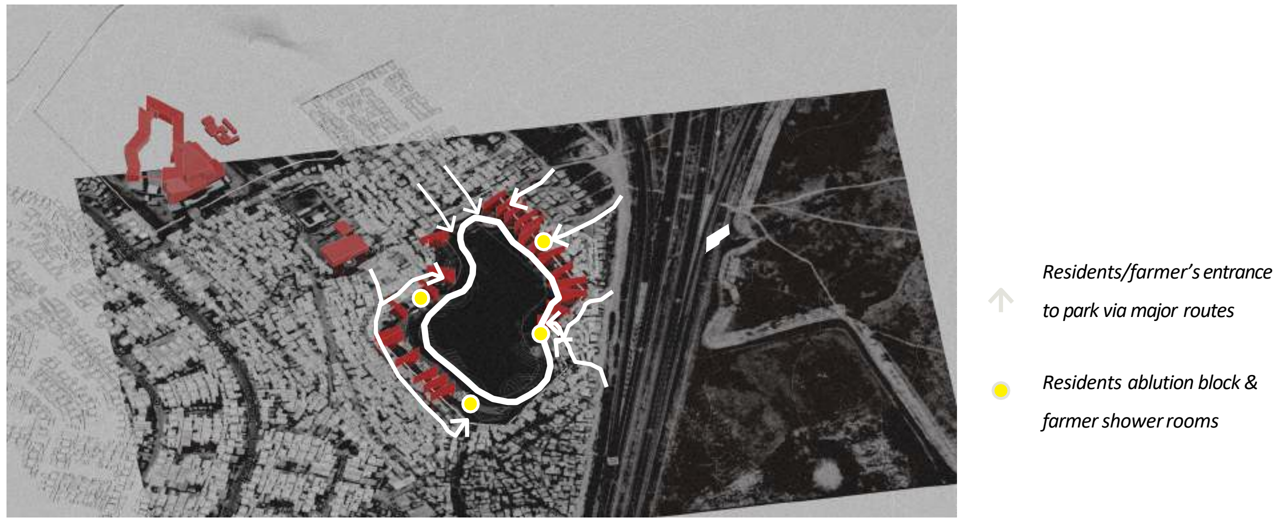
Phase 1: Urban vertical farms flow out of minor routes (pathways between shacks)



Phase 2: Park is built as a high street and public area for Dunoon

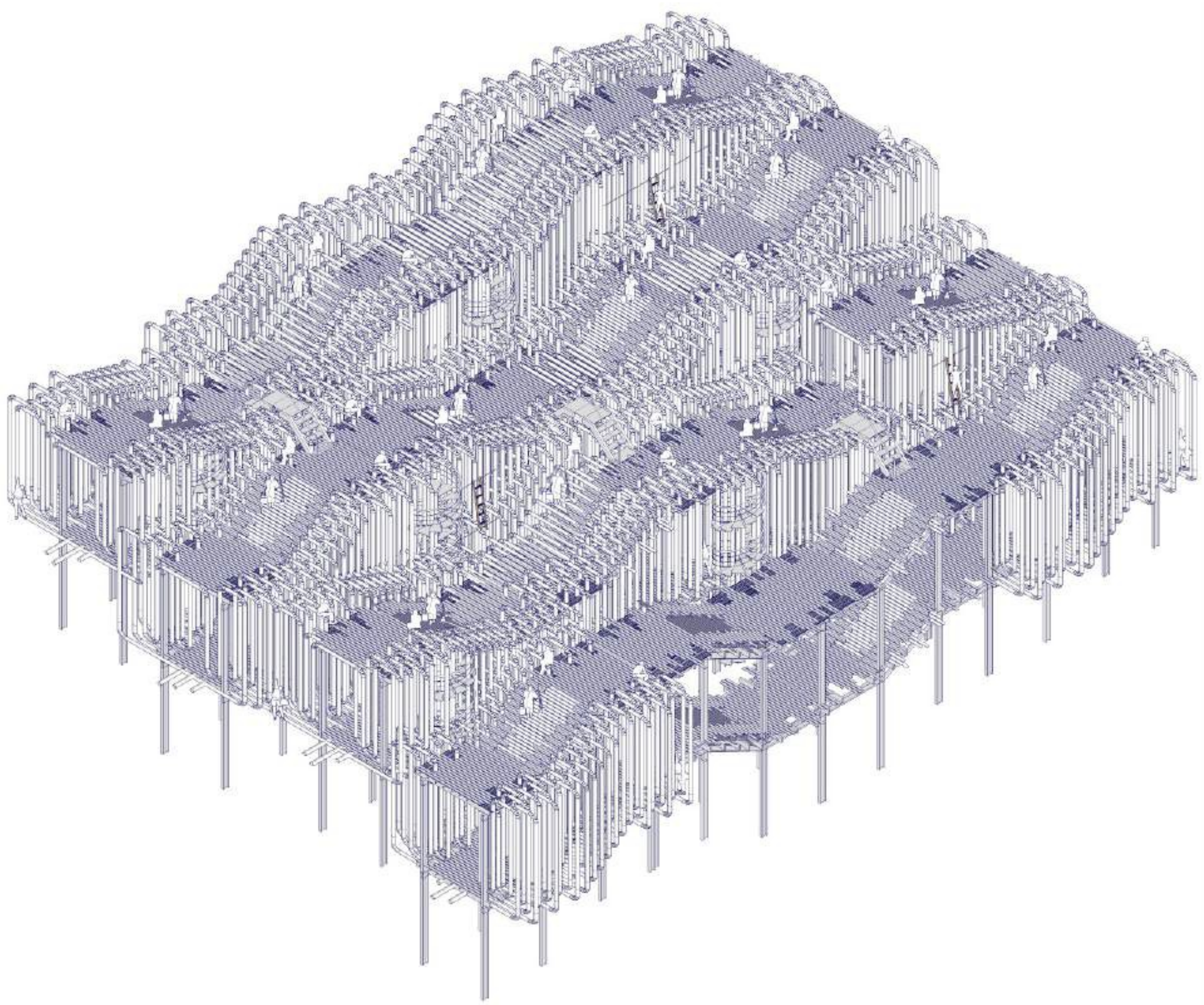


The quarry water is first emptied out and discarded. An NGO provides scaffolding as a kit of parts for the community to assemble the vertical hydroponic farm support structure. Wind and water pumps that clip onto thescaffolding.



Phase 3: Public facilities that service the farmers such as ablution blocks and public entrances anchored to major routes

Allotment scale



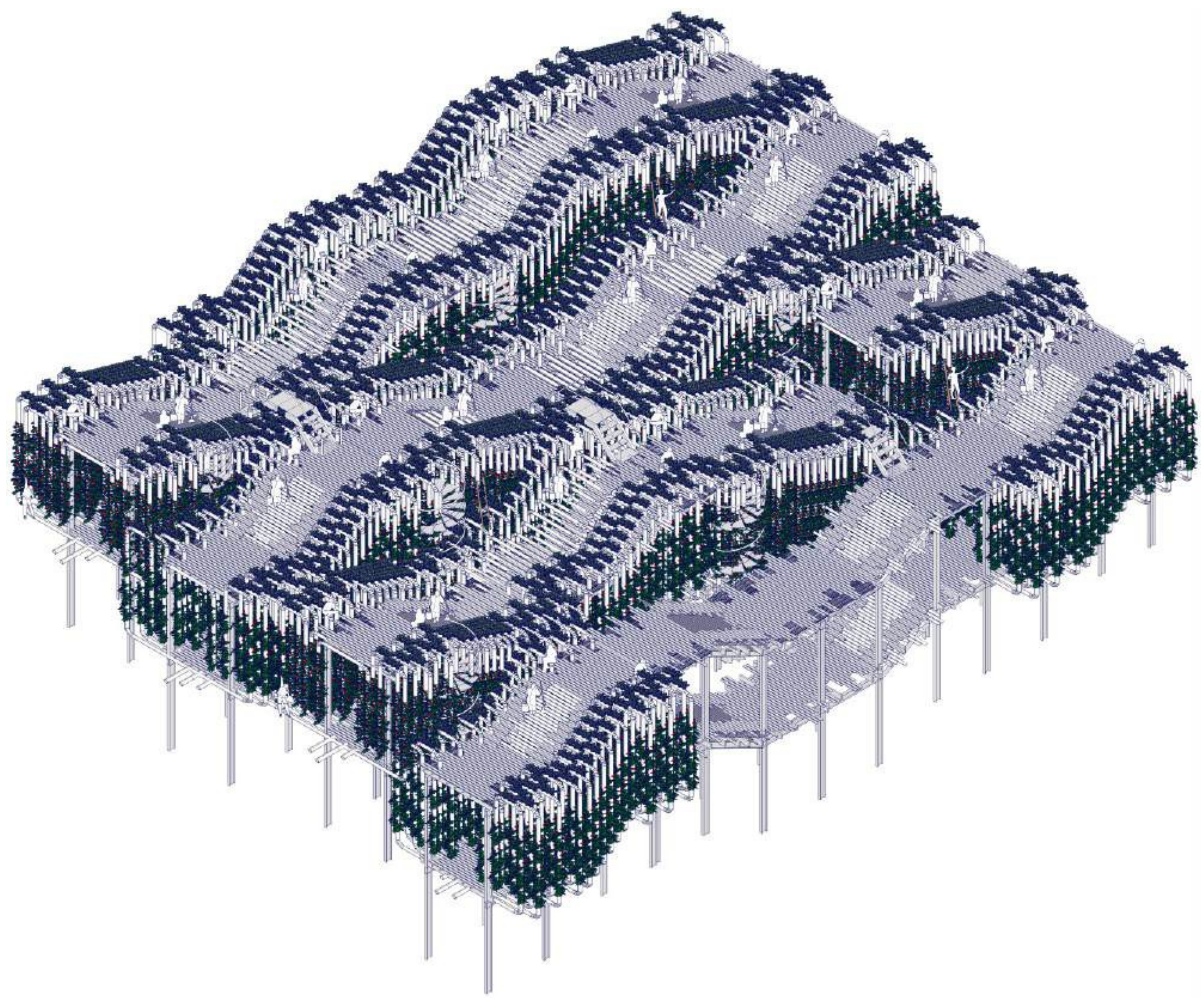


Fig. 31: *Imagined populated hydroponic farming allotments*

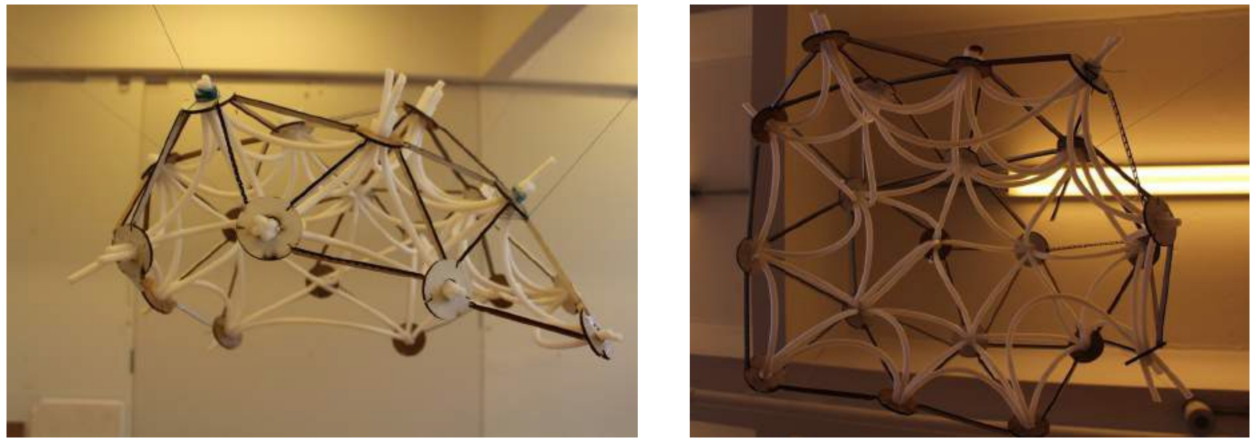


Fig. 34: Experimental model on how tubes can support clip–in structure.

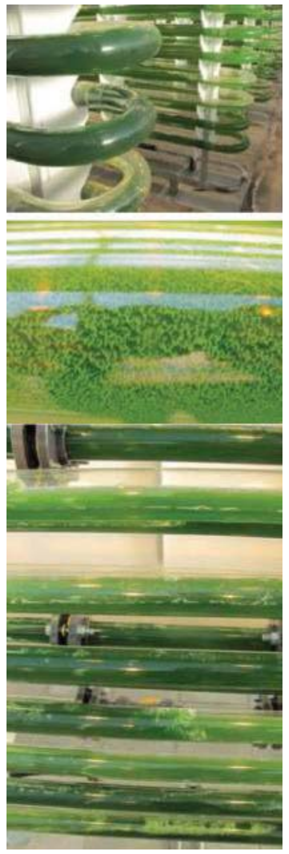


Fig. 32: *Acrylic stacked tubing with microalgae.*

Fig. 33: *Naturally occurring chemiluminescence*

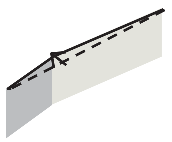
How can you make more affordable structure that is supported by a tubular system?

Instead of using conventional street or urban lighting for the parts of the intervention that may require use at night, such as ablution blocks. A system that could be supported by a living facade of chemiluminescent algae (glow in the dark algae) was designed. The model is the embodiment of this system. The cardboard represents a more affordable structural solution, such as the scaffold and clamping system. The tubes run diagonally to keep the chemiluminescence in motion. The chemiluminescence only lights up when the microalgae are disturbed. The continuous pumping of microalgae into the tubes, the gravity pulling the fluid down, and the vibrations from life on the farm will disturb the chemiluminescence and thus light up the quarry.

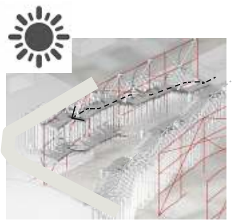
Vertical allotment farming

Once the scaffolding system (with water system) is in place, the vertical hydroponic pipes are clipped onto the system to be used by residents nearby.

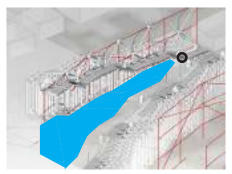
The scaffolding is rotated slightly to optimise north–westerly sun, as this is the most ideal for farming. The rotation also enhances the stability of the structure. Much like a folded piece of paper.



The farms are all uniquely configured. However, the general rule is that the typical vertical allotments, connected to the minor routes, are lifted above the park to maximise sun exposure. The walkways from the major routes will sink into the park walkway.



Grey–water may be spilt in–between the structure into the undulating filtration system (reed beds).



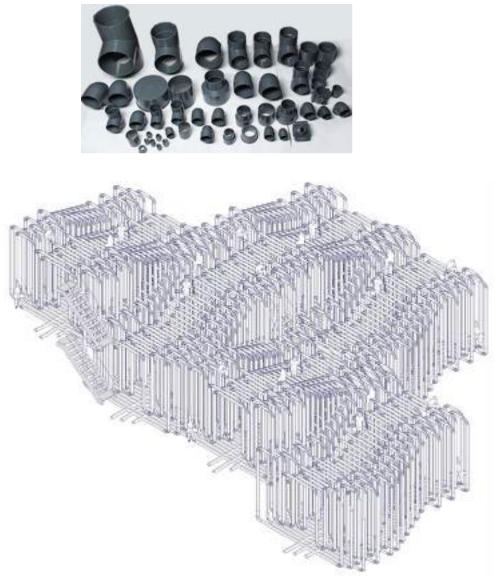
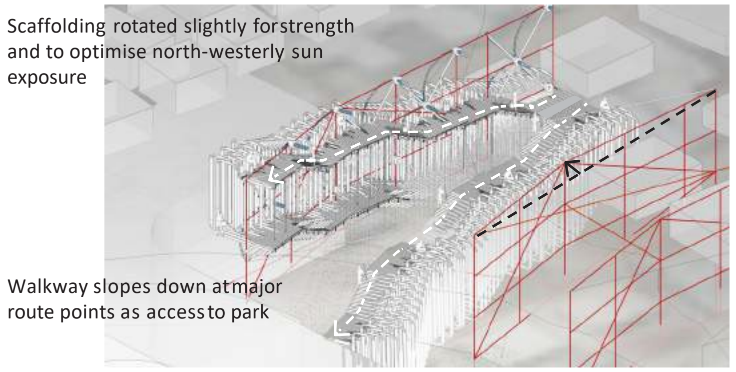
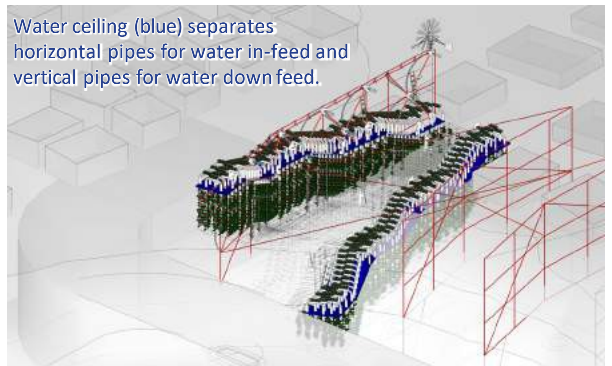


Fig. 35: *Above Pipe structure: Multi-component structure of a PVC pipe. Many parts that need to be assembled to make a whole.*
Below: How pipes can be assembled.

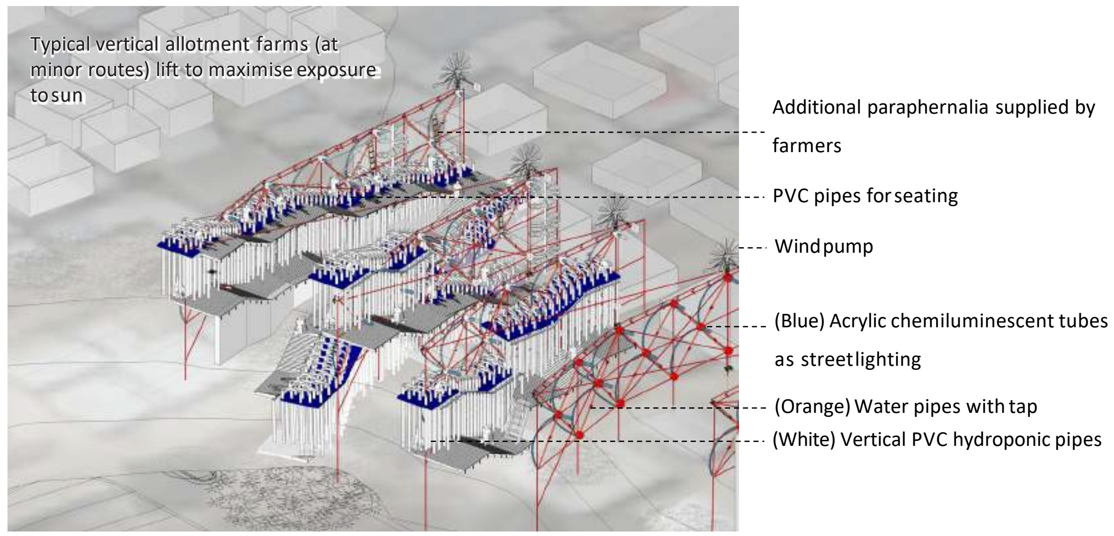
Fig. 36: *Above: Vertical hydroponic growth techniques using pipe structures.*
Below: Horizontal pipes used for seating and vertical pipes used for growing leafy greens, tomatoes or herbs.



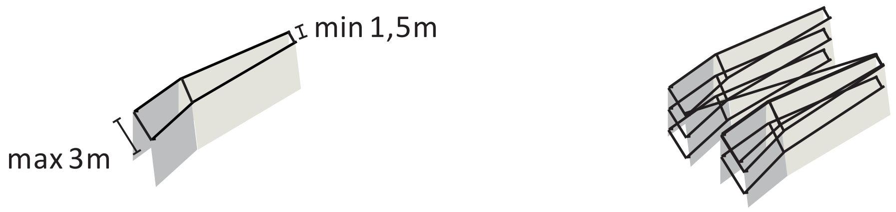
Vertical hydroponic pipes are hung on racks supported on scaffold system.



Vertical hydroponic pipes get fed by quarry water which is pumped by wind pump and falls by gravity into water pipes to be opened by tap.

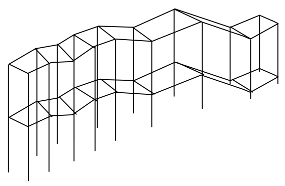


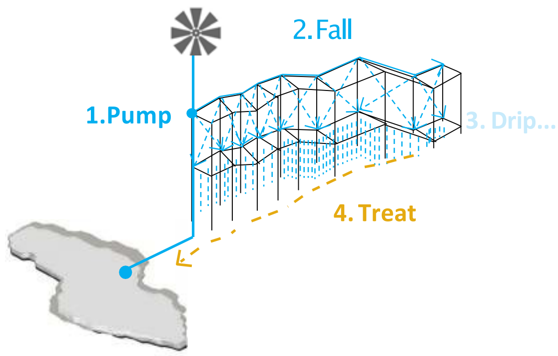
More vertical allotments are assembled and added as time passes.



Structural stability

The scaffolding is doubled up to further support the structure. The end of the structure widens to a maximum of 3 meters. The doubled scaffold groups are supported by diagonal struts.





Loosen the scaffolding

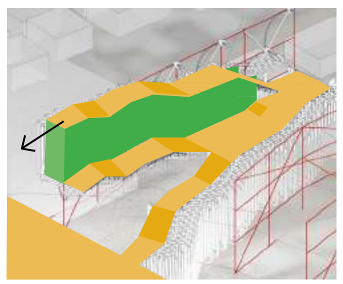
The scaffolding rises with the vertical allotments.

Water diagram

The water from the quarry gets pumped up and falls down the structure via gravity.

Hydroponic pipes drip used water onto the ground where it becomes treated by vertical lagooning.

Quarry viewing deck

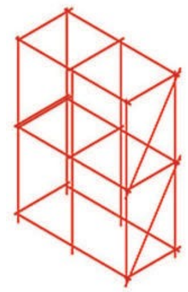


Public: Public circulation space

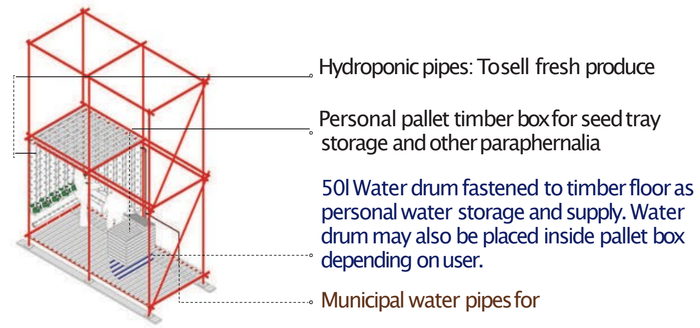
Farm space

D.I.Y. CONSTRUCTION

Scaffolding: other suggested configurations



Scaffolding

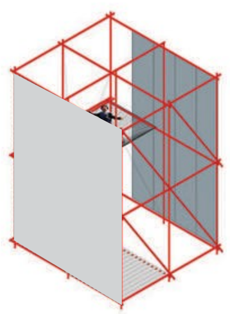


Small scale produce market space

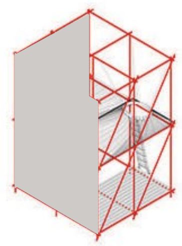
Hydroponic PVC pipes hung on racks with cold bent aluminium sheet drip below for water catchment

Acrylic tubing used as shading device

Mesh or fabric material used as shading device



Child play space



Child play space

Laundry hang

Laundry hang with wash bay

Turning the quarry into a farming park is part of fostering a responsible appreciation for public water devices, fundamental to ecological and environmental values. With the scale and potentially damaging effect of modern industrial and urban outflow in mining (considering the Durbanville Quarries north of site and this sites history), there is a limit to the indiscriminate use of water as a depository for waste. The long-term effects of this system could be immeasurable.

This approach echoes historical attitudes that have taken advantage of water as a valuable asset and the way in which it can enhance the immediate surroundings. Readapting these old water filtration techniques and circulations has increased the scope for moving greater volumes of water for practical activities such as washing laundry or for visual effect. The quarry as a green space also allows an increase in leisure time activity. It encourages the capacity to enjoy a visually attractive and sympathetic environment that is synonymous with urban renewal. The park becomes an extension of the community center's gymnasium. The architecture of the water park can identify the visual and experiential pleasures that water can convey and can also affirm man's custodial role. The value that is being designed is not simply a system that creates a waterfront/water feature/water park in Dunoon but is an index of continuing human enlightenment and integrity.

This by no means is a finite solution to the social ills of society. This dissertation acknowledges the limits of architecture to 'save' an urban condition. However, this research is a step in the direction of an intervention that considers the societal ills and sees them as an opportunity to understand the human condition and create beauty from contemporary ways of making.

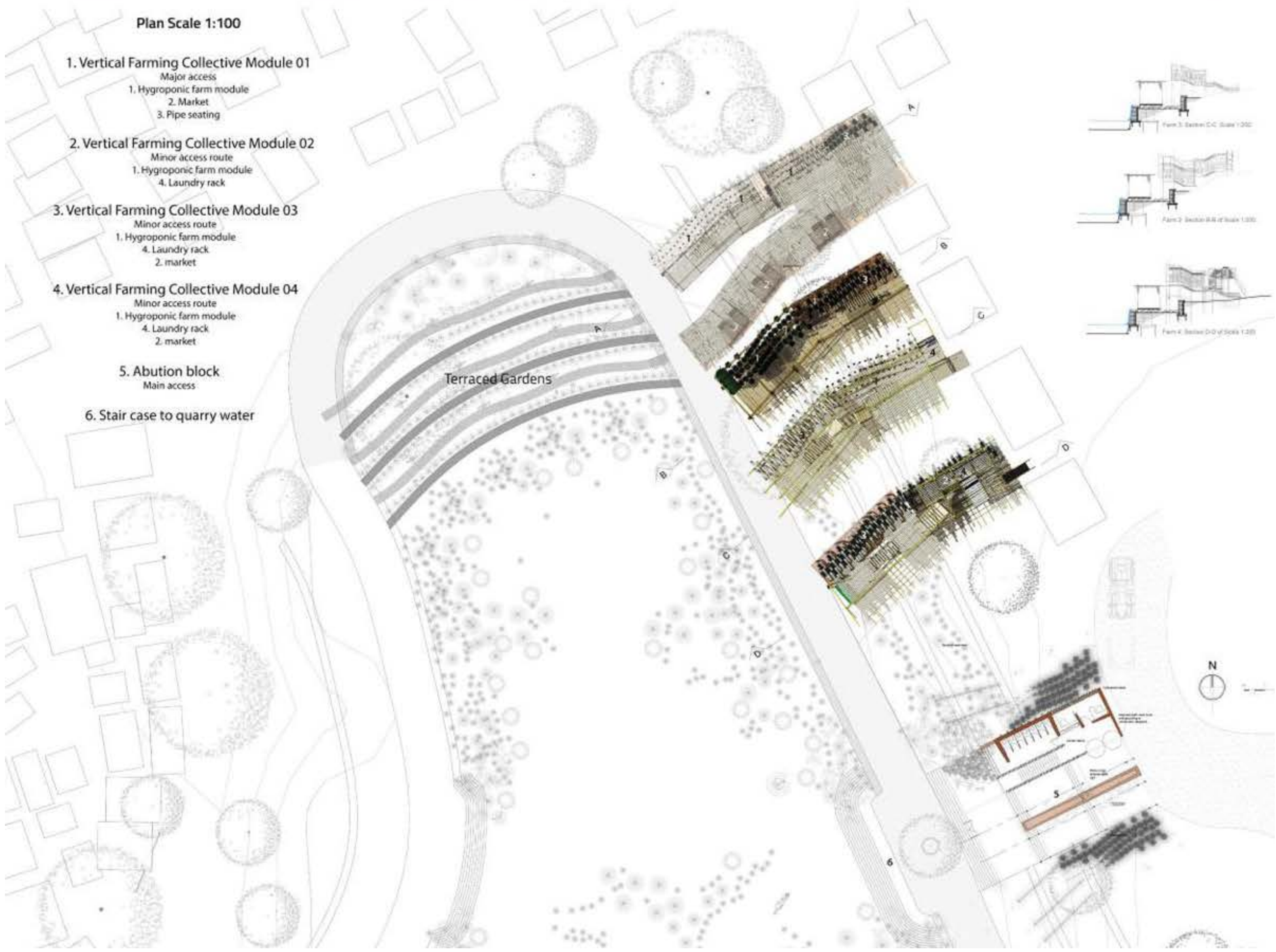
Conclusion

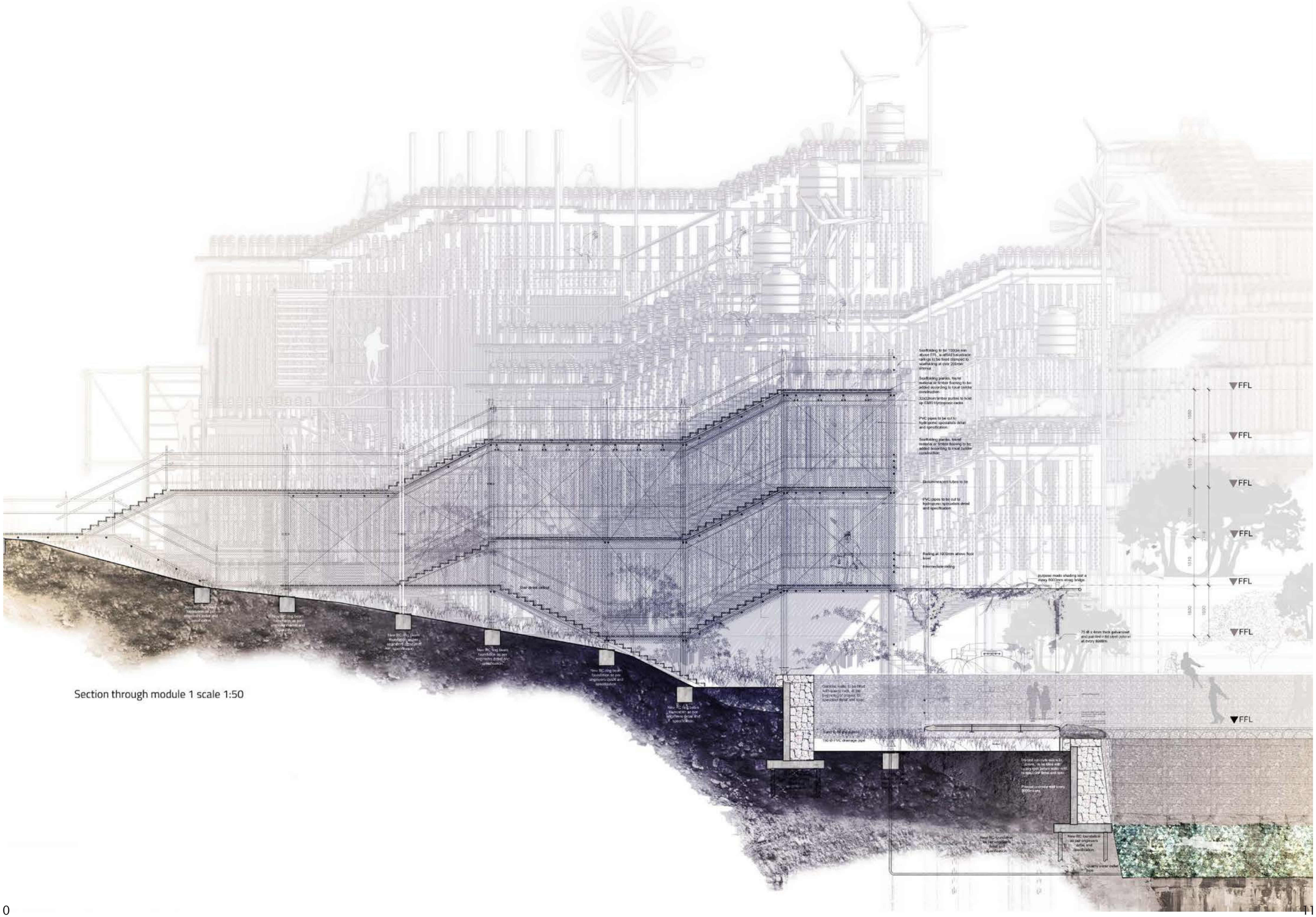
This dissertation began with a passionate interest in the social milieu of townships in places demanding land reform. Metaphysical ponderings developed the idea that routed water is an ecological condition. In this sense, a way of thinking became the starting point for the research rather than the desire to solve a problem.

A site was found through the unfolding of the anomalies in Dunoon by understanding Dunoon as the quotidian. The found quarry embodied the research focus. In an attempt to understand and rethink land ownership and resource benefit from a political perspective, to an innate system – found in polluted stagnant water at the base of a century old quarry into a cyclical water system – became manifestly apparent.
An intentionally emphatic attitude towards a bio-inspired future as the projections of the fringes of our cities.

Along the quarry, a series of pre-existing activities were noted along the periphery and provided for architecturally. Farmers, NGO facilitators, walkers, joggers without tracks, children without playgrounds, women without laundry water tipping points are brought together in Dunoon quarry by the water. They come to life by its usefulness and may potentially live within a forest of green in a place once barren and bare. They are a part of a cyclical life cycle, routed in the quotidian.

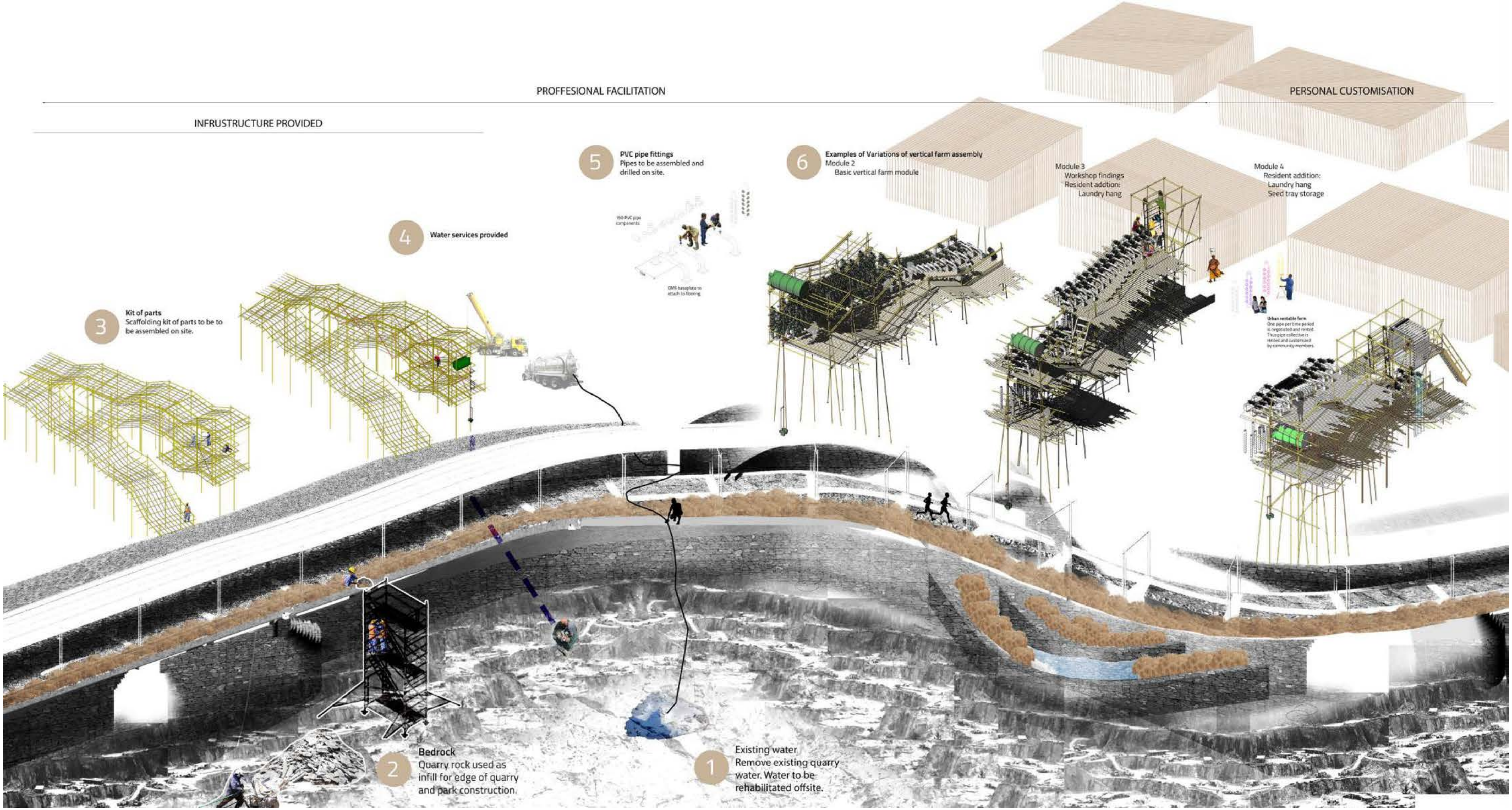
The new quarry fringe Final proposal





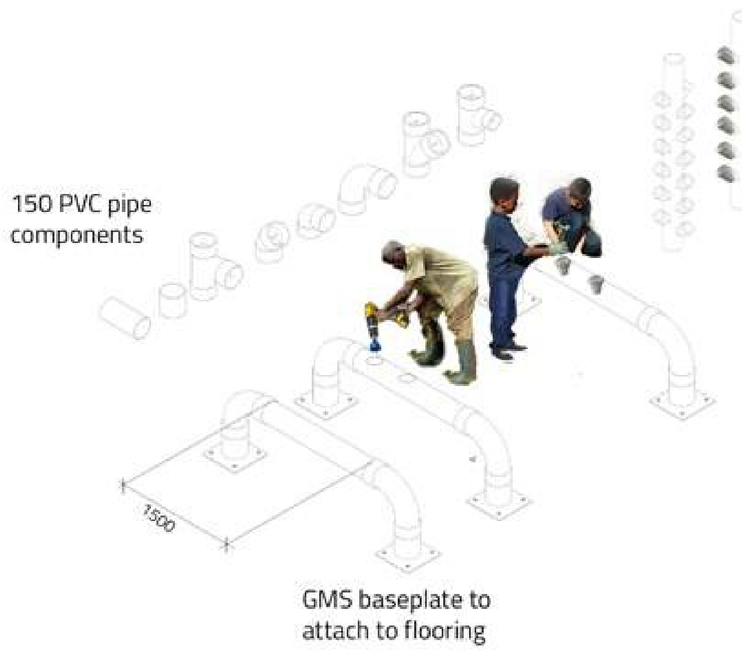
Section through module 1 scale 1:50

Construction phasing

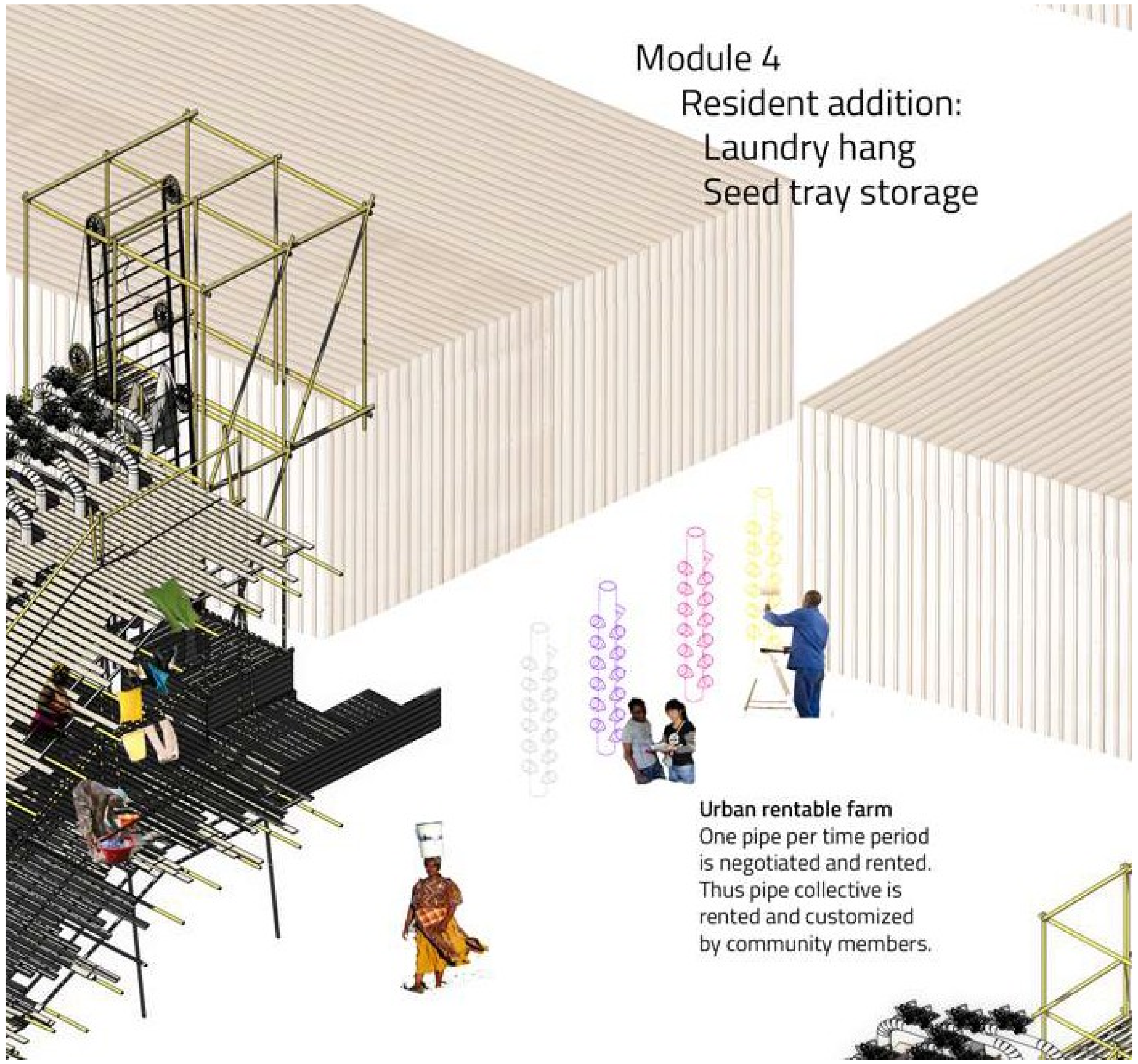


5 **PVC pipe fittings**

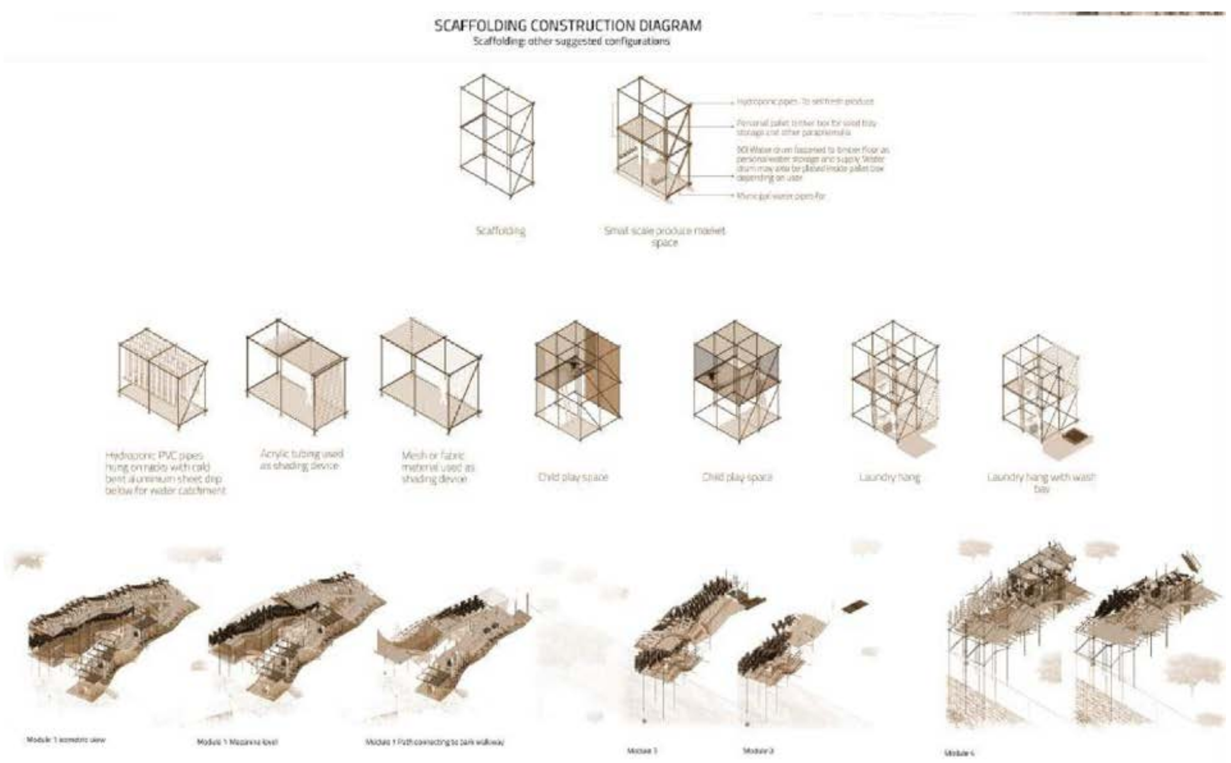
Pipes to be assembled and drilled on site.



Vertical Farm Personal Customisation



Farm customisation



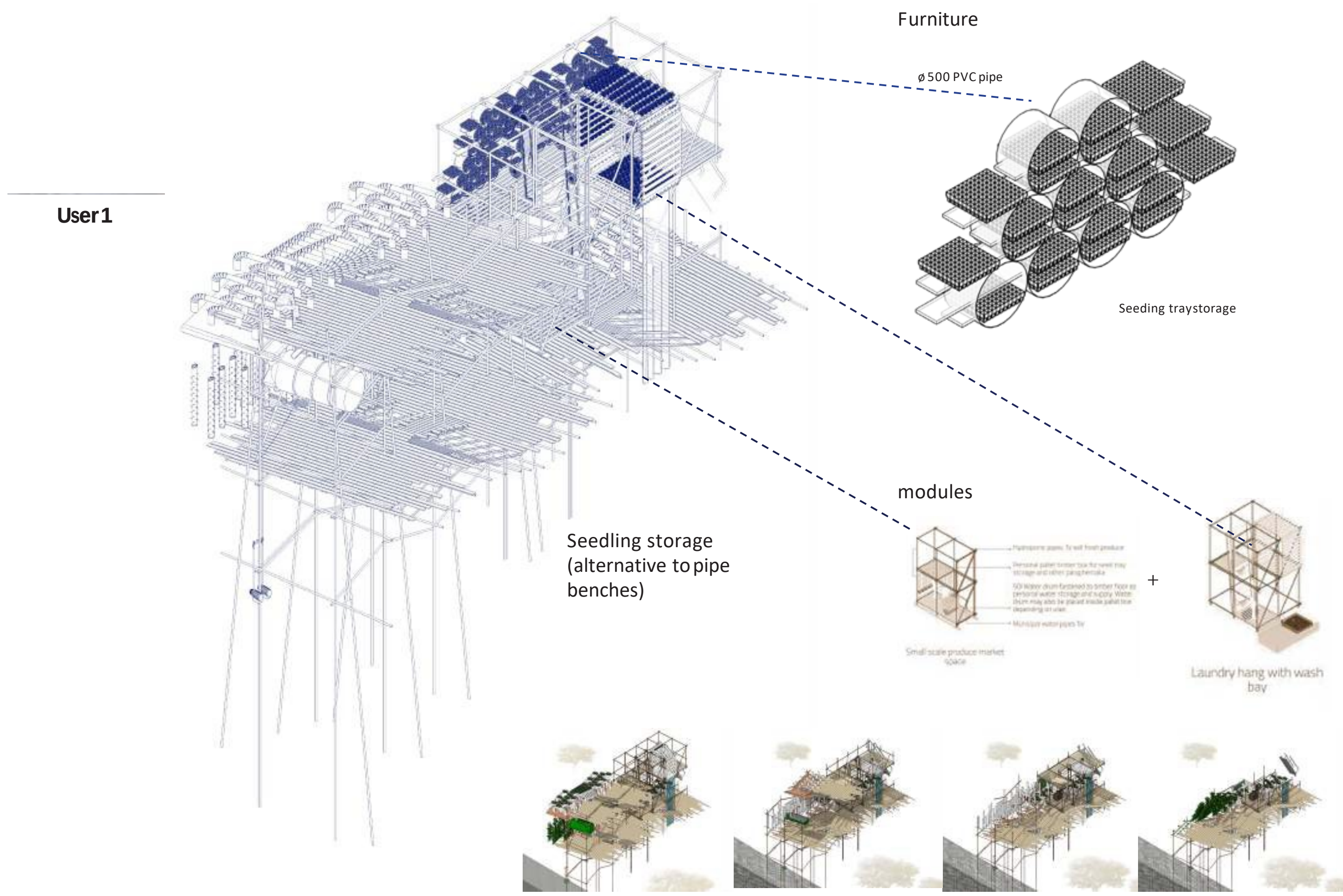


Fig. 37: *An example of personal customization by site resident*

Minor route to farm view

Farm view

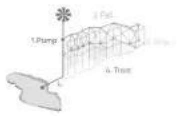
Park view

Structural stability

The scaffolding is doubled up to further support the structure. The end of the structure widens to a maximum of 3 meters. The doubled scaffold groups are supported by

Loosen the scaffolding

The scaffolding rises with the vertical abutments.



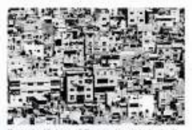
Water diagram

The water from the quarry gets pumped up and falls down the structure via gravity.

Hydroponic pipes drip used water onto the ground

Hydroponic pipes drip used water onto the ground where it becomes treated by vertical lagoons.

Productive-scape



Projected future of Dunoon's yet to be built fabric

Dense vertical infrastructure

Collage of proposed entrance to quarry

Concept development towards vertical hydroponic farming

Translation to quarry periphery

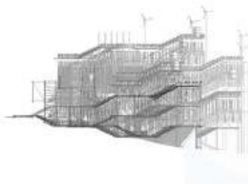
Infrastructure that cleans water run off into quarry

Urban intervention using scaffold structure and treated ground to slow water feed into quarry

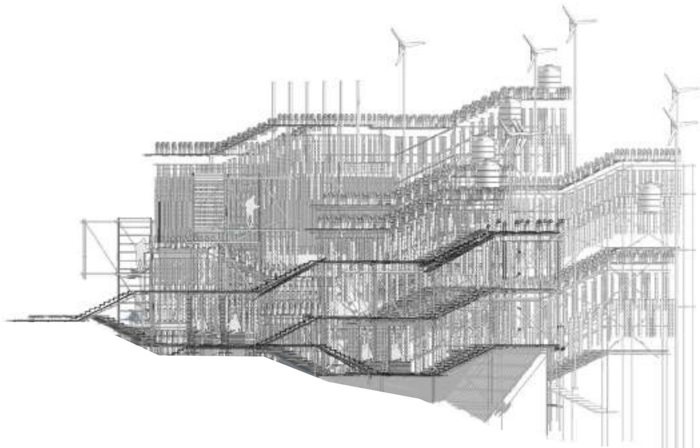
Terraced farm on edge of quarry

Terraced farm on edge of quarry

Section through vertical farms and pots



Section through vertical farm



Hydrunoon

Construction manual

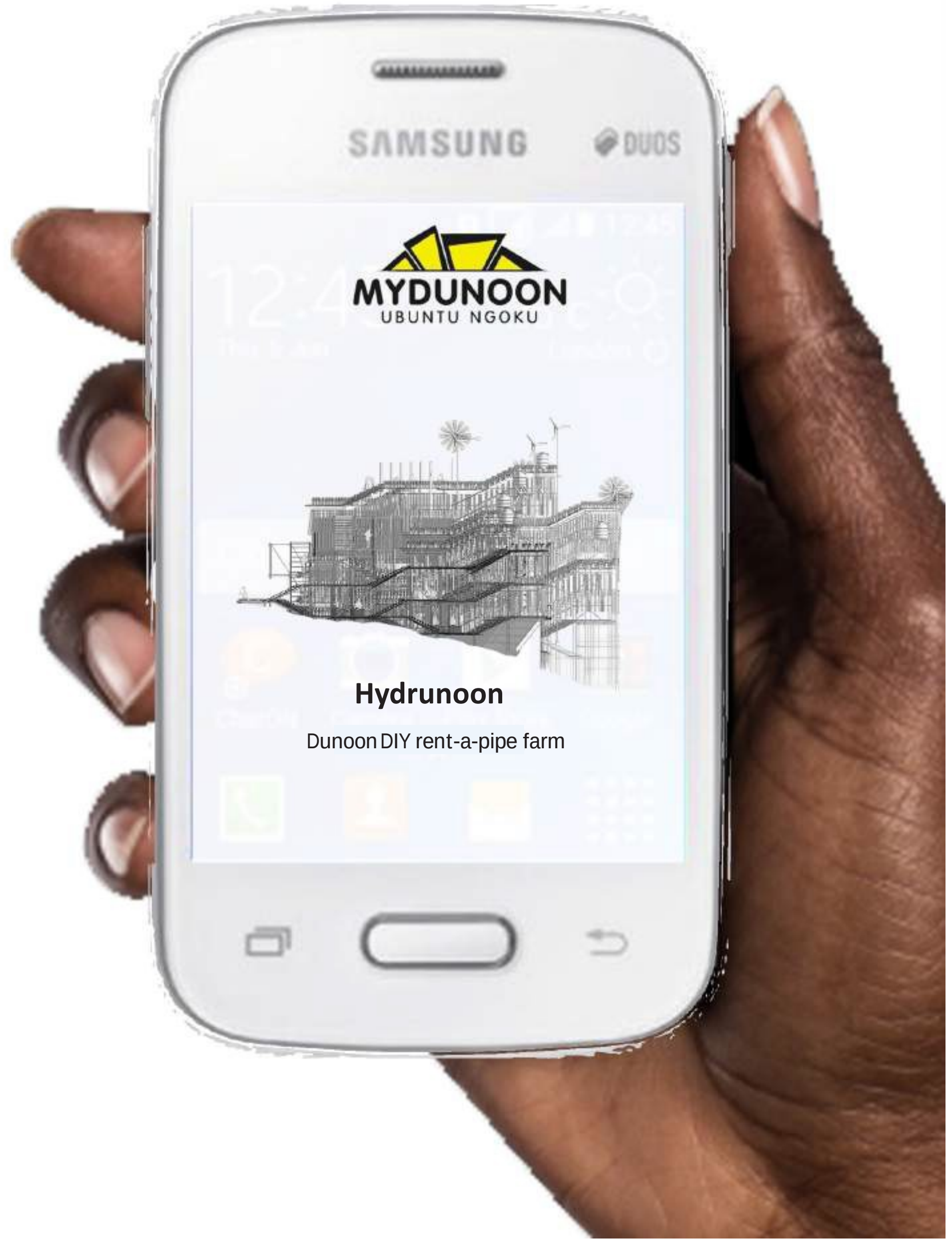
Construction Phasing

Scaffolding costrcution

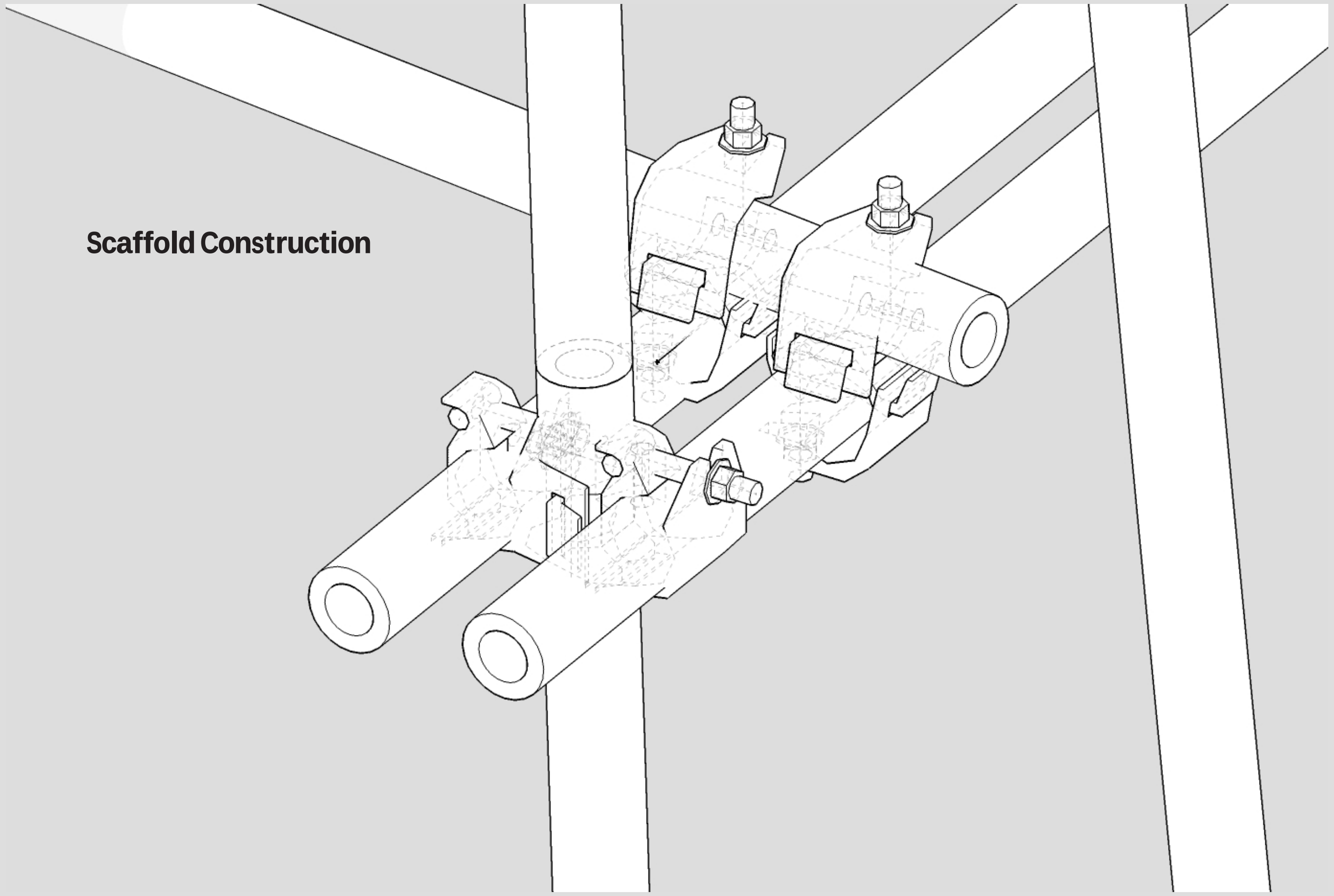
Pipe rent

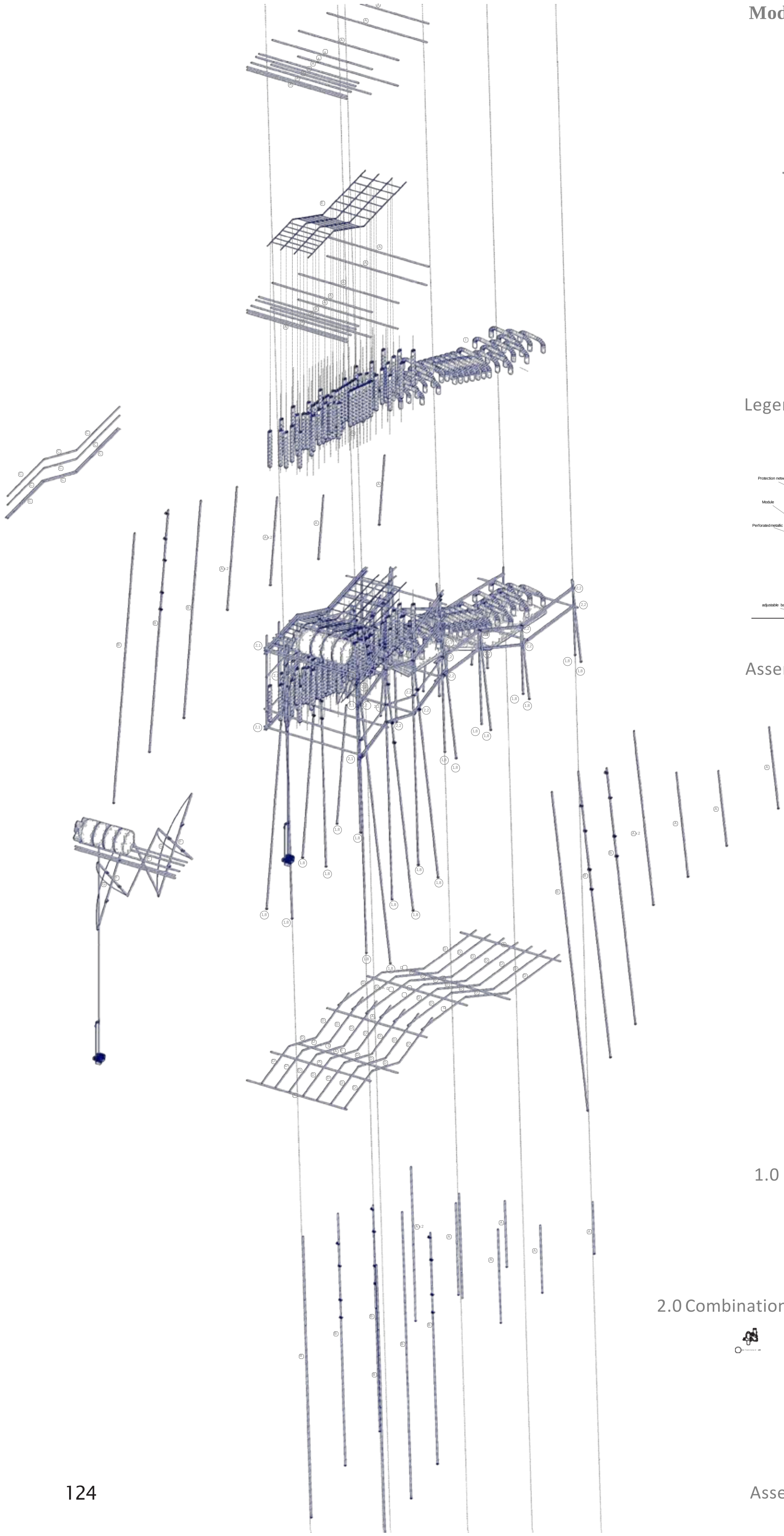
How pipeswork

Farm Customisation

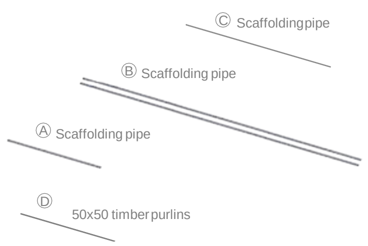


Scaffold Construction





Module 2 parts



Ⓔ Stainless steel rack

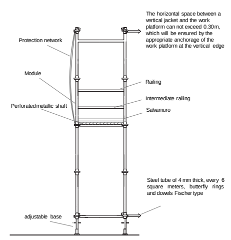
Ⓕ Cross Bracing for water pipes

Ⓖ Bioluminescent tubes

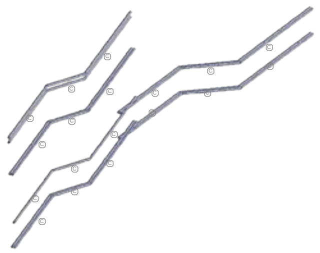
Ⓗ hydroponic pipes

Ⓘ Pipes for seating

Legend

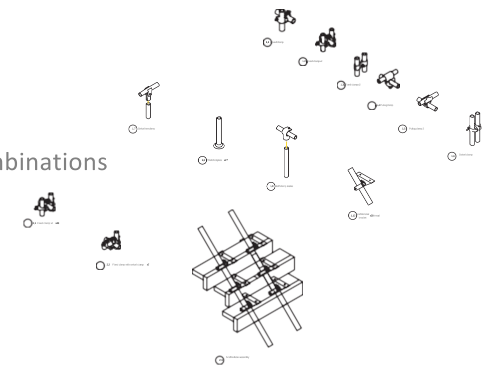


Assembly guide Scale 1:50

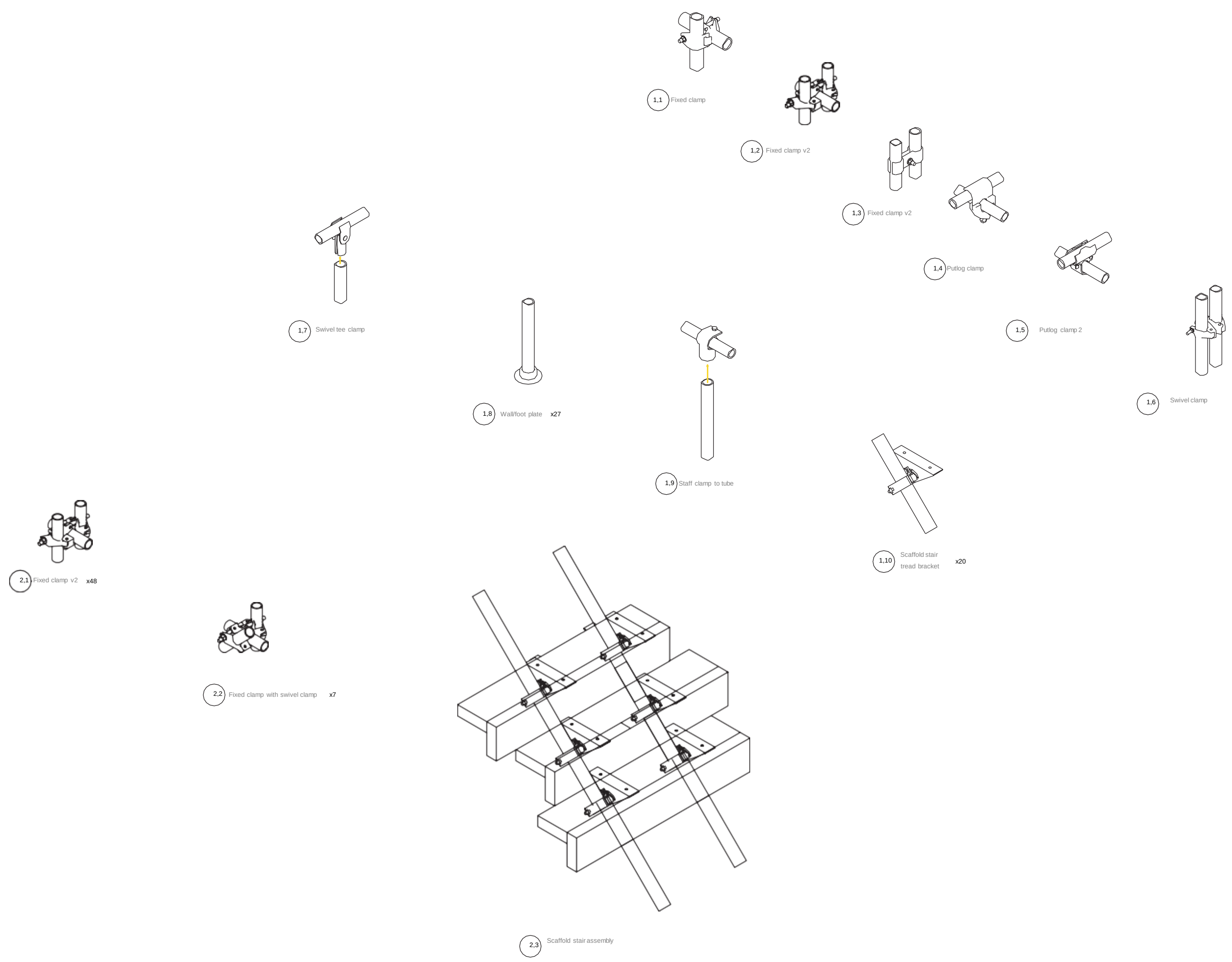


1.0 Individiual connections

2.0 Combinations

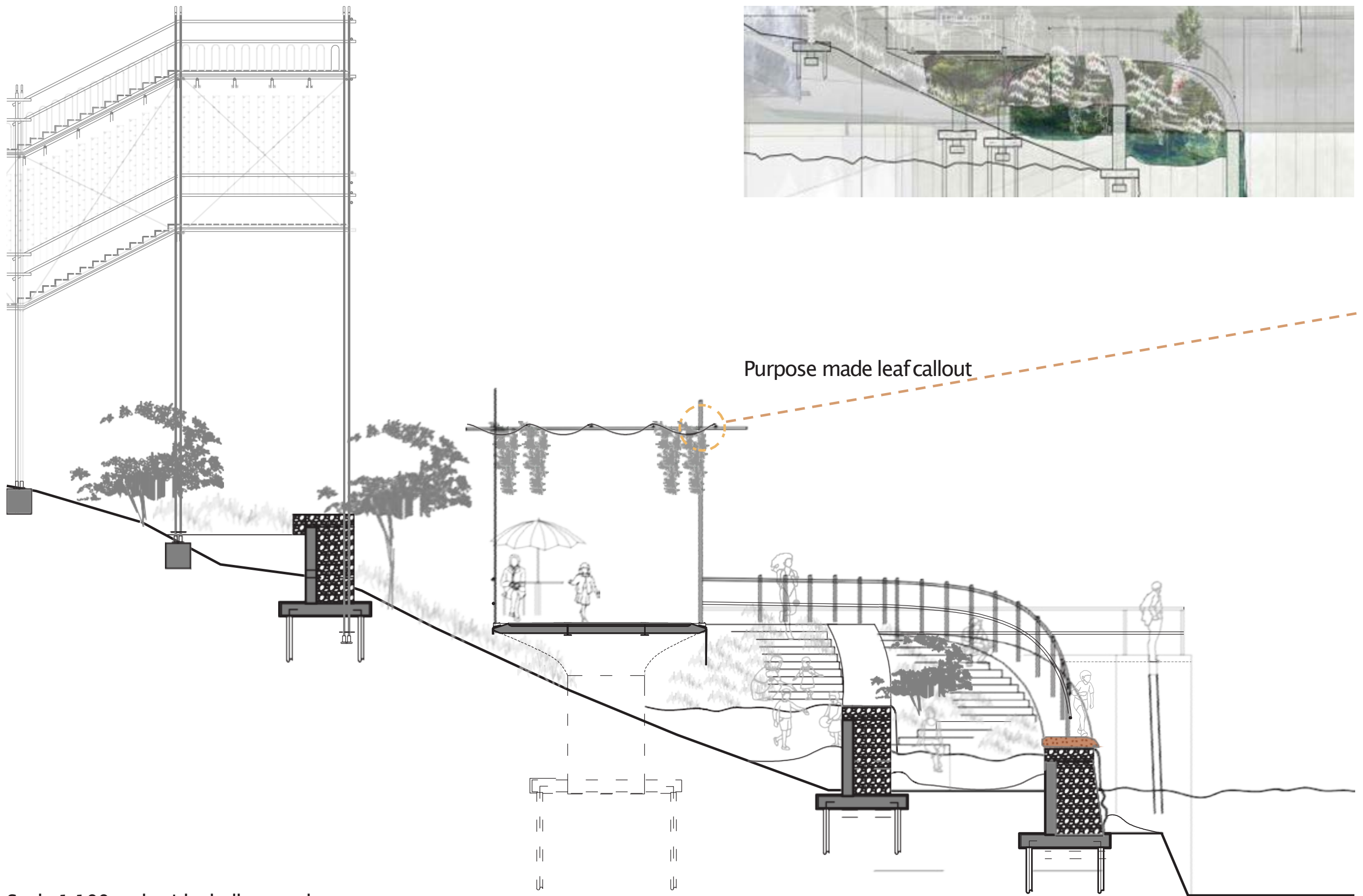


Assembly brackets Scale 1:10



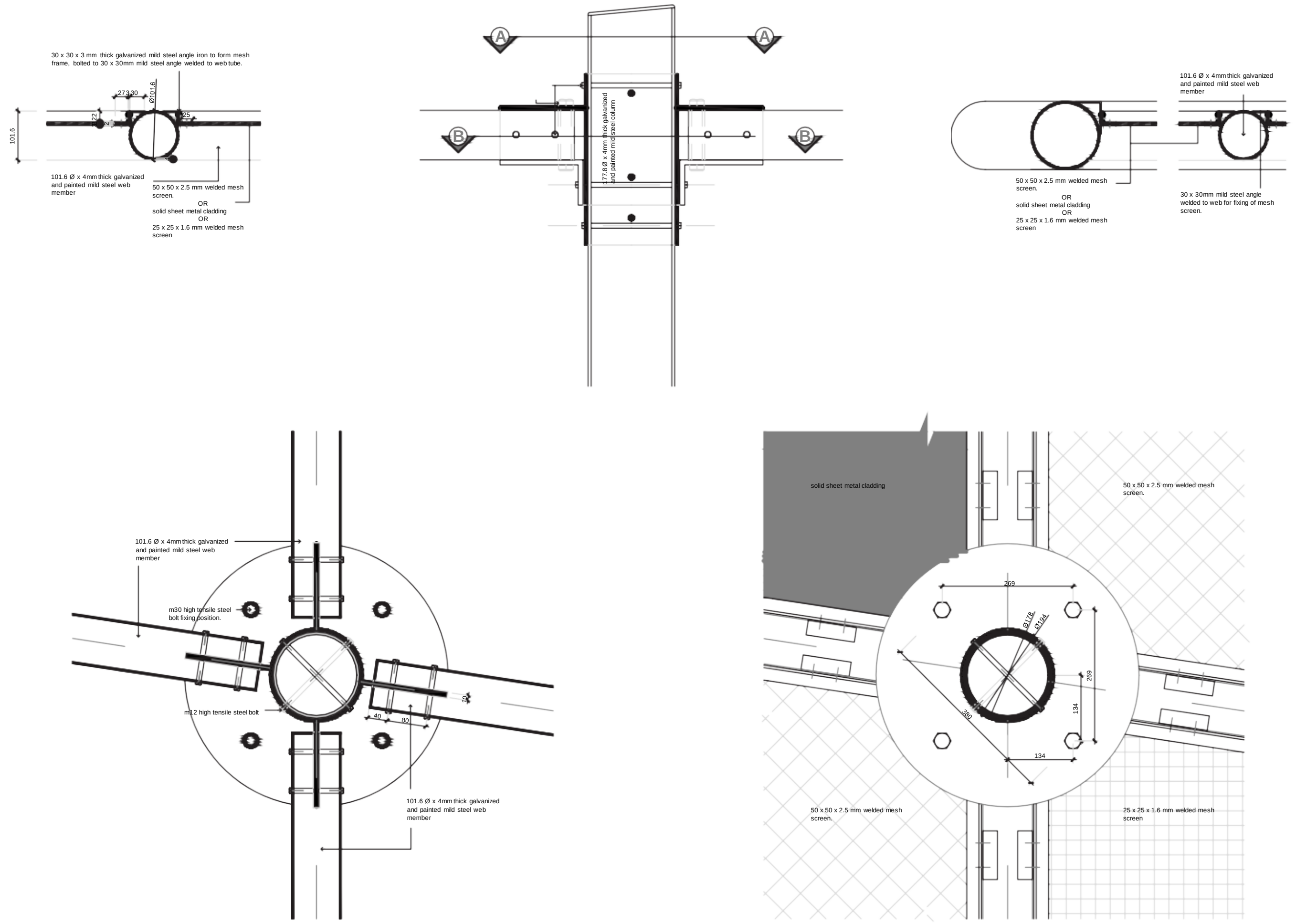
1.0 Individual connections

2.0 Combinations



Scale 1:100 park with shallow pool

Purpose made canopy details Scale 1:10



Model pictures

Fig. 39: *Quarry and N7*

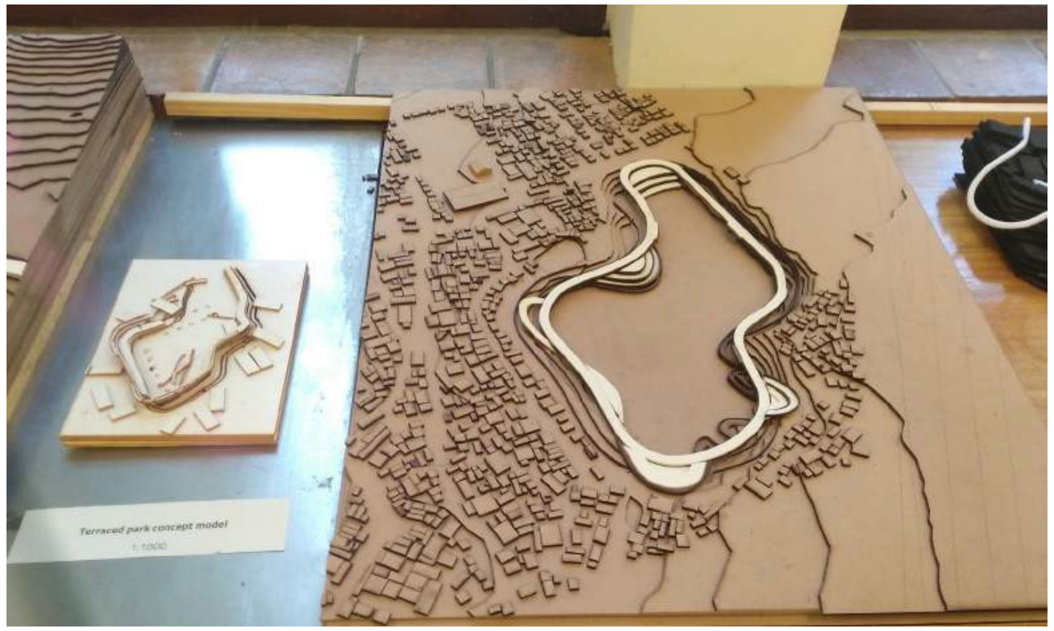


Fig. 38: *Urban park*

Fig. 42: *Module development*

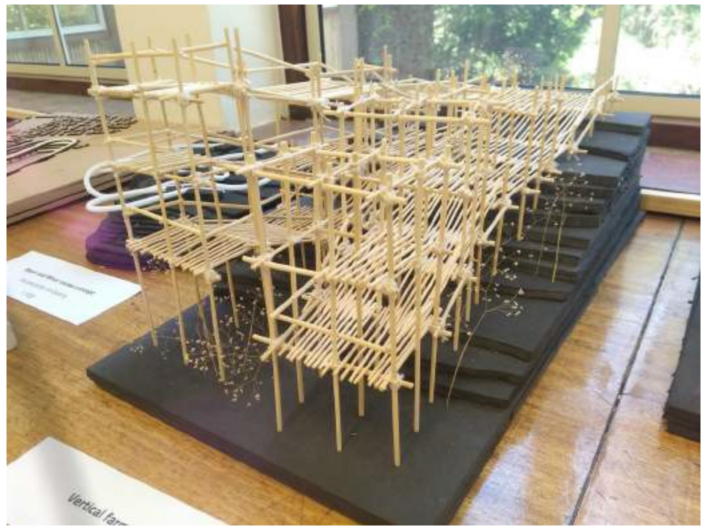


Fig. 41: *Module 1*

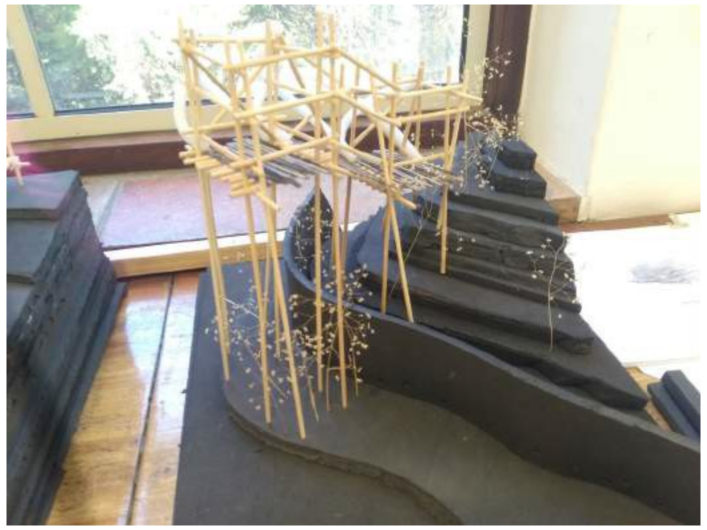


Fig. 40: *Module 2*

List of figures

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Application for Approval of Ethics Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data.The objective of submitting this application *prior*to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook**(available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Nwabisa Madyibi
Department		Engineering Built Environm
Preferred email address of applicant		Mdynwa001@myuct.ac.za
If a Student	Your Degree e g , MSc, PhD, etc ,	M.Arch (prof)
	Name of Supervisor (if supervised)	Nic Coetzee, Kevin Fellingh
If this is a researchcontract, indicate the source of funding/sponsorship		Click here to enter text.
Project Title		Rooted/Routed

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Nwabisa Madyibi		25 Mar 2017

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)			23/6/20 Click here to enter a date.
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1, and for all Undergraduateresearch (including Honours)			
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions	Click here to enter text.		Click here to enter a date.